EECT 223 Lab Notebook

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Professor: Mr. Bell

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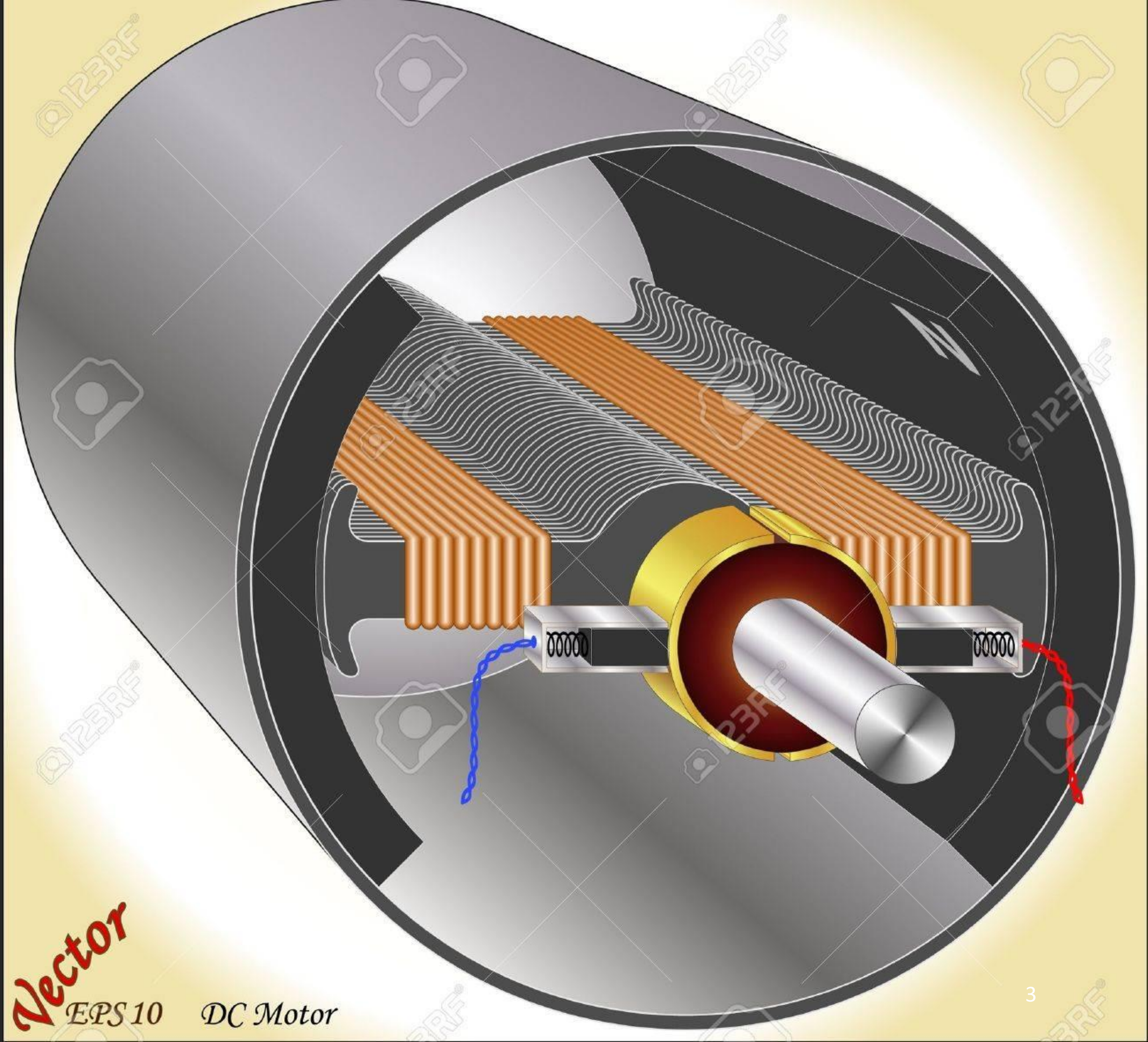
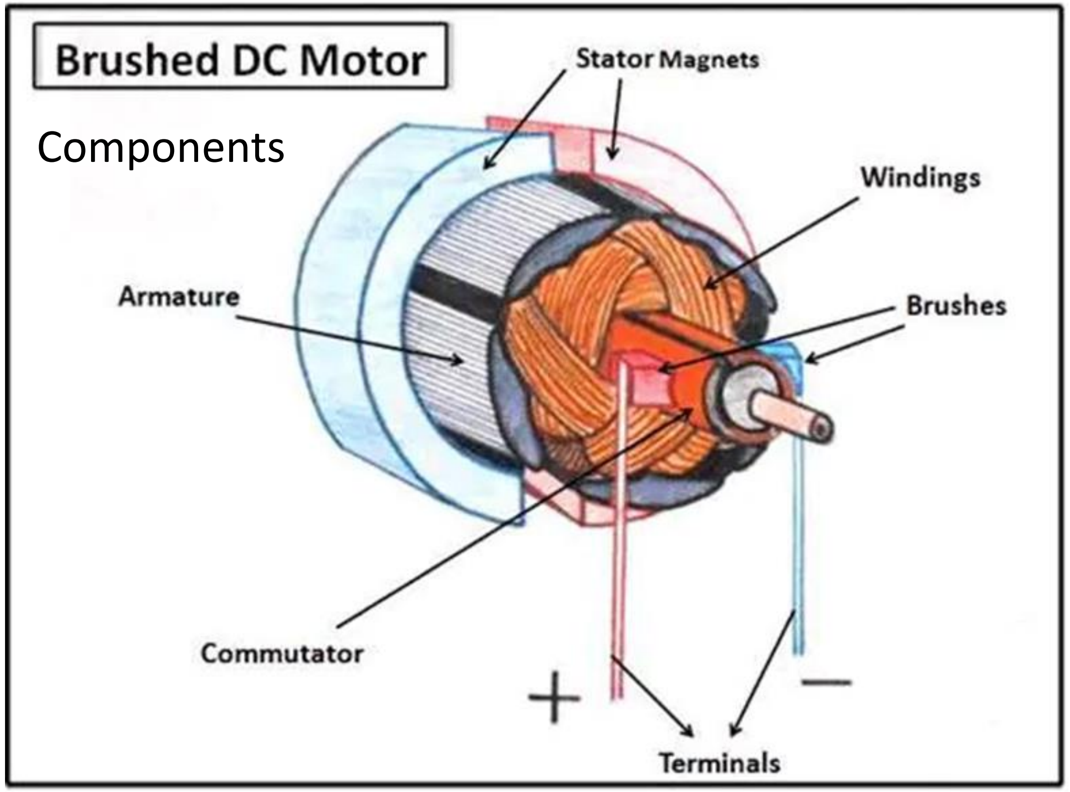
Lab 1 How DC Motors Work





Lab 1: How DC Motors Work

- Dc motors work by turning electrical current into mechanical energy by utilizing electromagnetic fields.
- The current travels up the terminal to the brush that makes contact with the commutator and then to the armature winding which creates a electromagnetic field which in turns reacts to the polarity of the stator magnets and starts to turn.

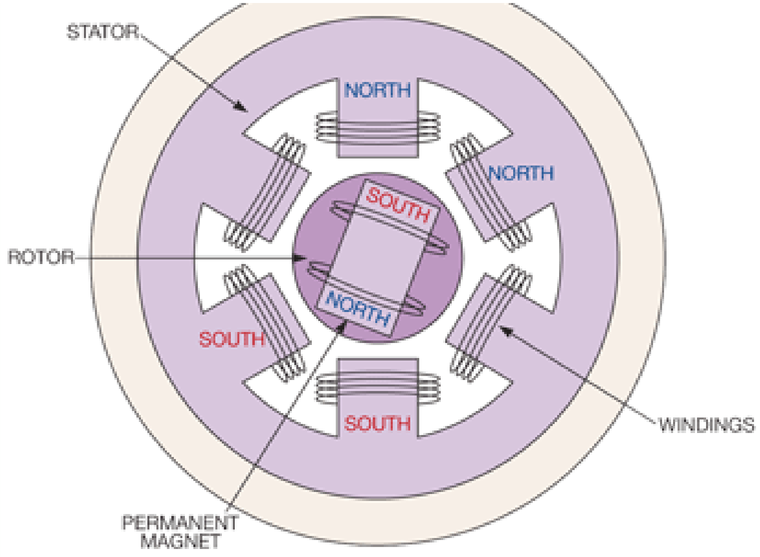
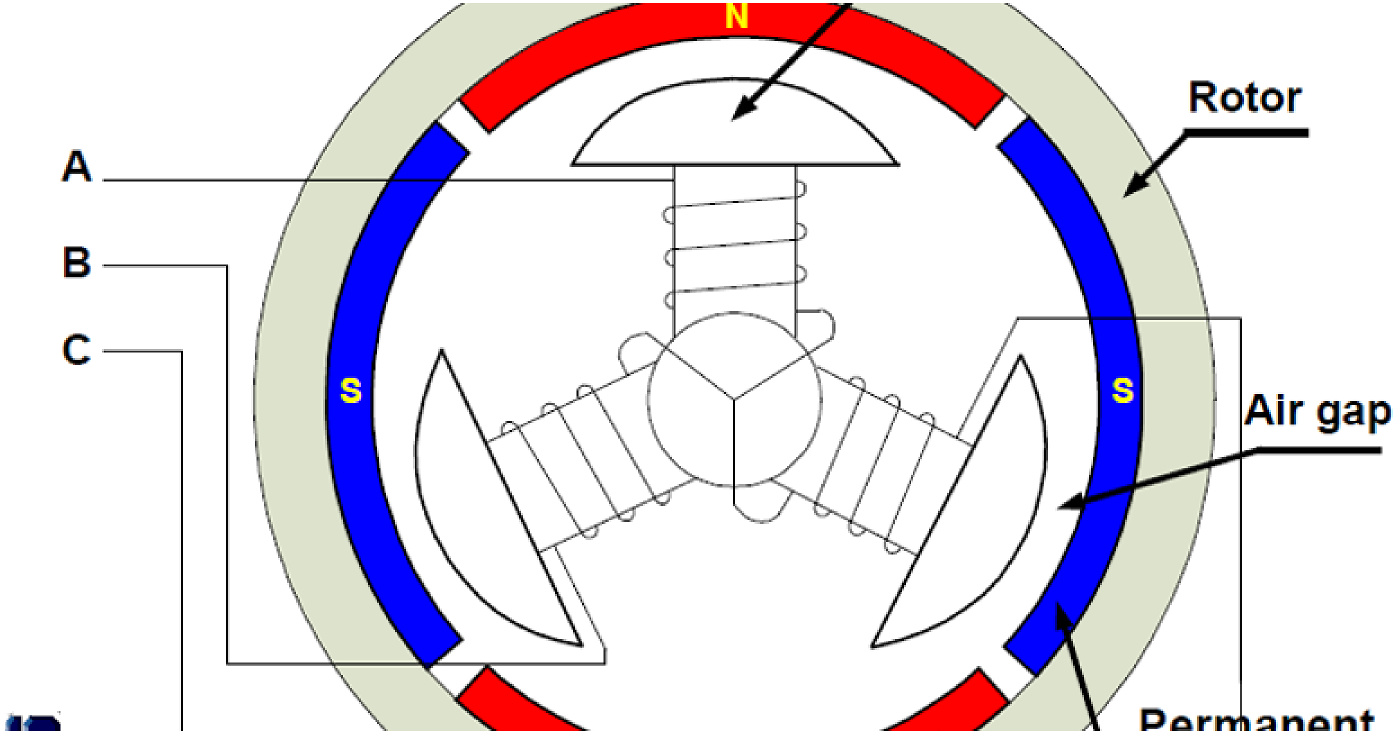


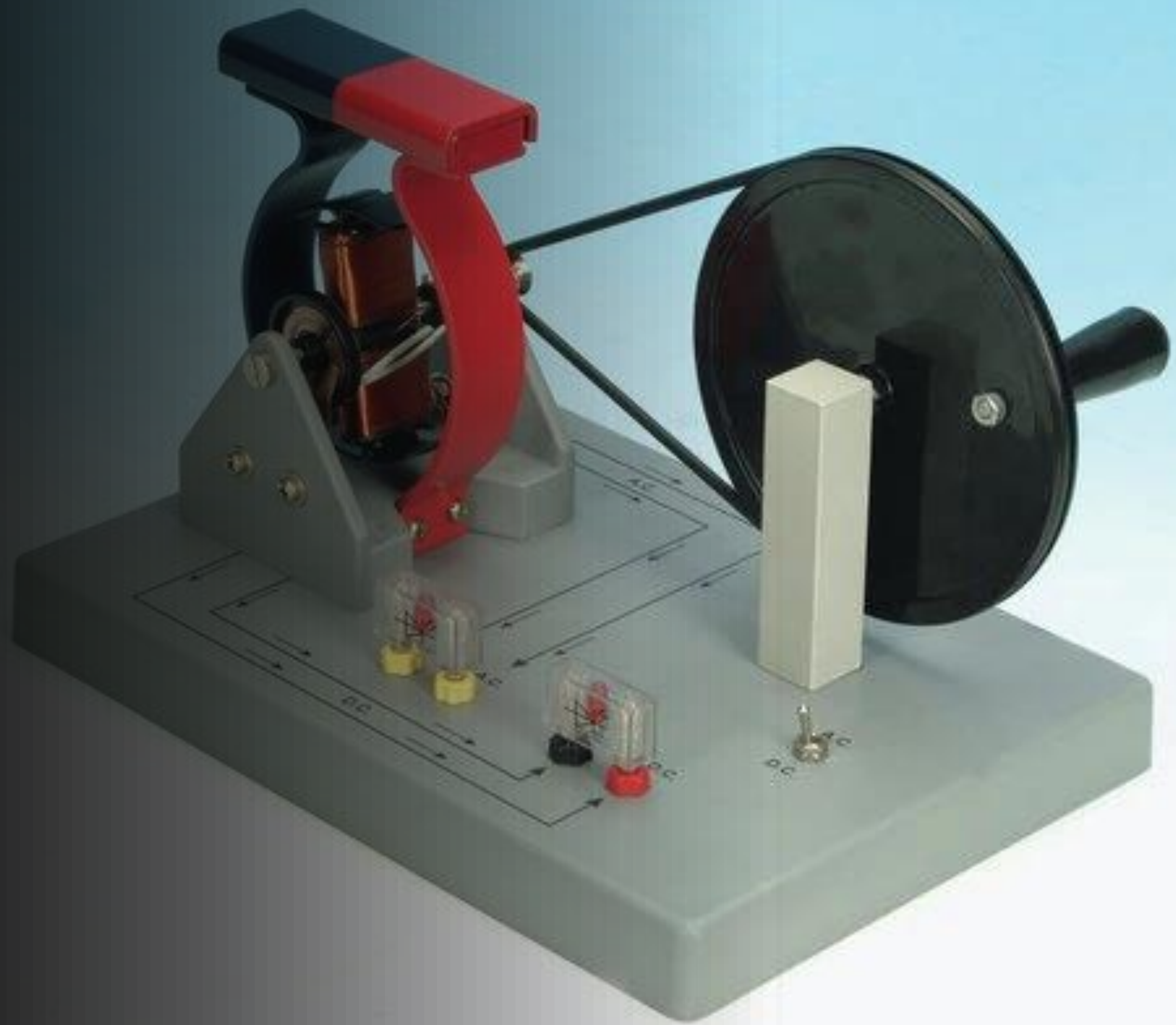
Figure 1 BLDC motors have a rotor with a permanent magnet containing north and south poles. The stator comprises multiple electromagnets.



Lab 1 How DC Motors Work

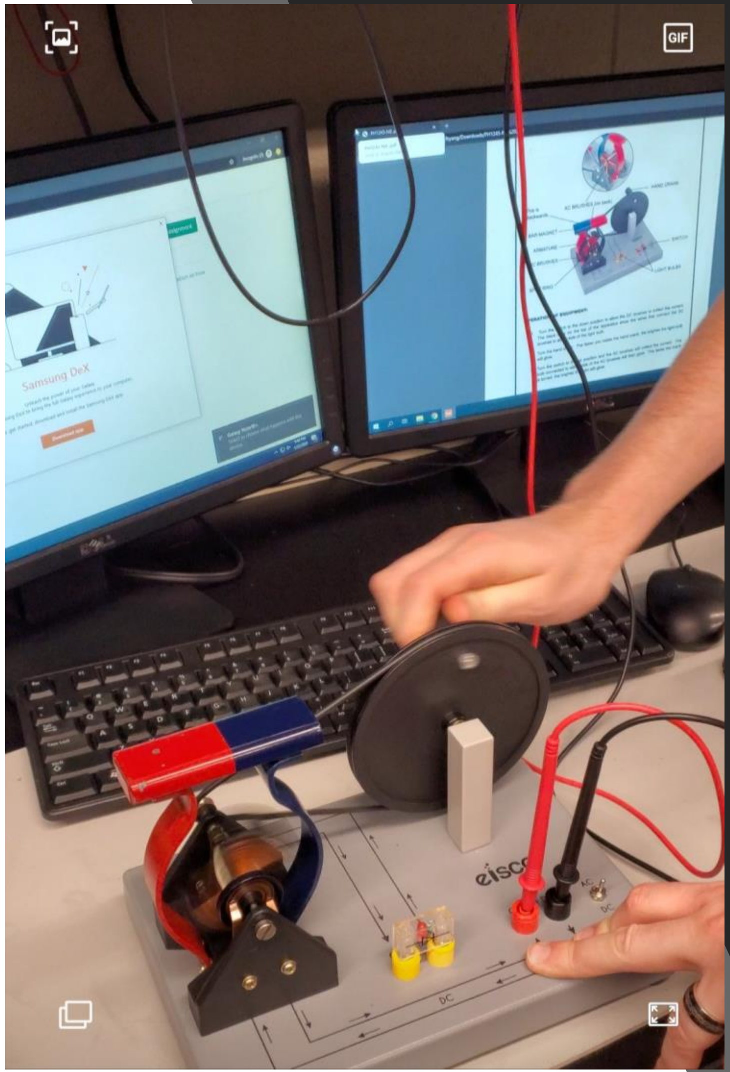
BRUSHLESS DC MOTOR

Lab 2 Eisco AC/DC Generator



Lab 2 Eisco AC/DC Generator

- Materials required
- 1 Eisco AC/DC Generator
- Multimeter

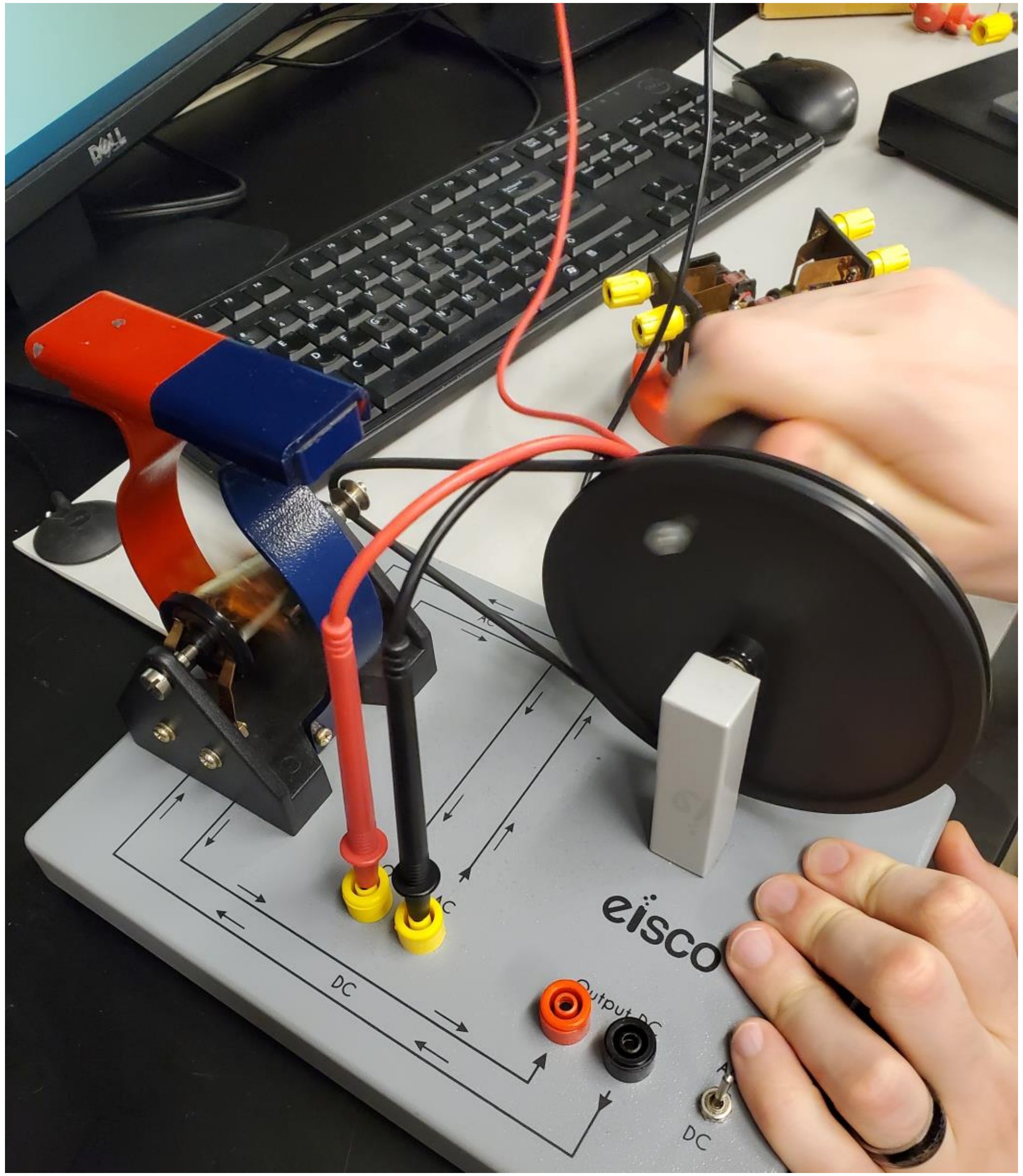


Lab 2 Eisco AC/DC Generator

- DC portion: we decided to 6 three runs at 10seconds to see if we could get an average rpm reading at 1v of output.
- We ended up with 107.983 rpm/ 1V after the 6 attempts

Lab 2 Eisco AC/DC Generator

- AC Portion: we performed the same tests as we did for the DC portion.
- The results out of 6 tests was an average of 76.3 rpm / 1V



Lab 2 Eisco AC/DC Generator

- Observations: we initially got power then tried it without the magnet on top to see if it would do anything and no power was produced.

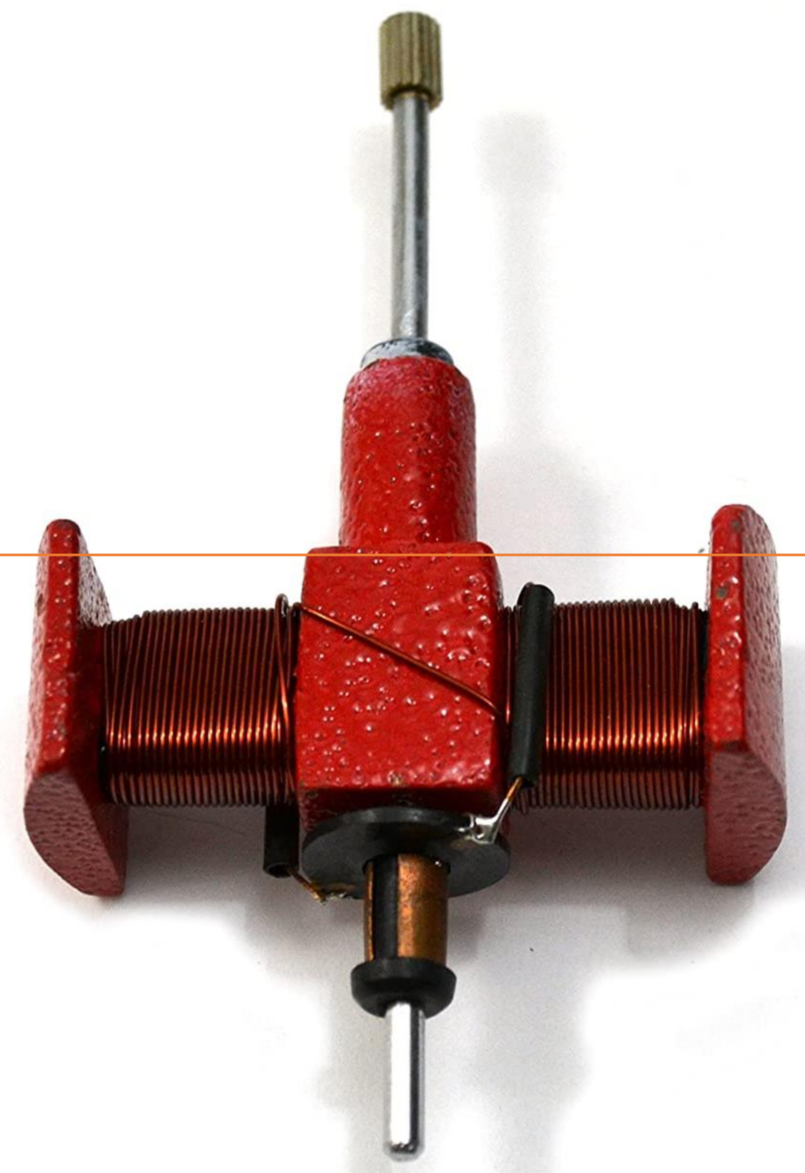
Lab 3 - Demo Electric Motor PH1237

Equipment needed

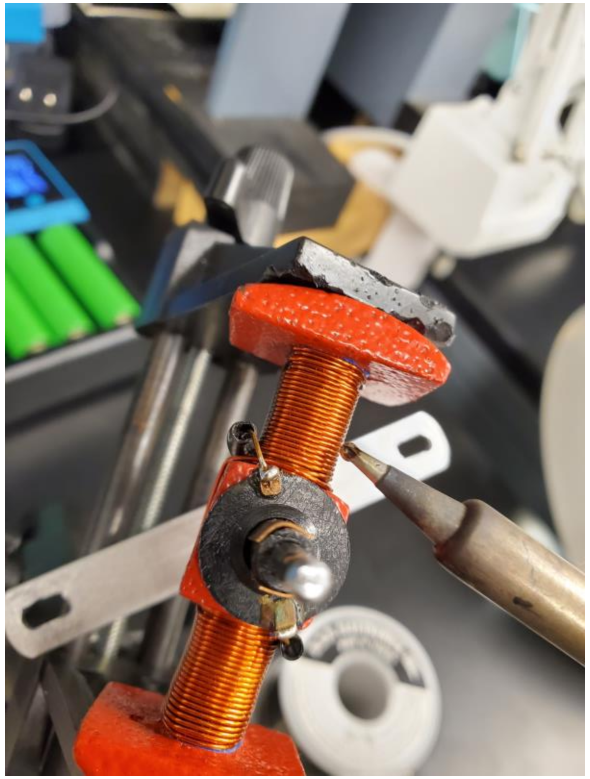
- Eisco PH1237 electric motor
- 2 Pole Armature
- 3 Pole Armature
- 4 Pole Armature
- DMM
- Power supply

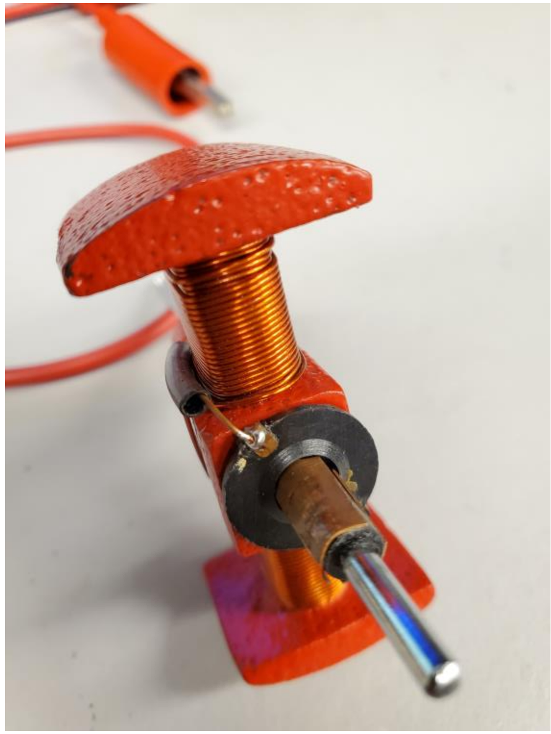
Lab 3 - Demo
Electric Motor
PH1237

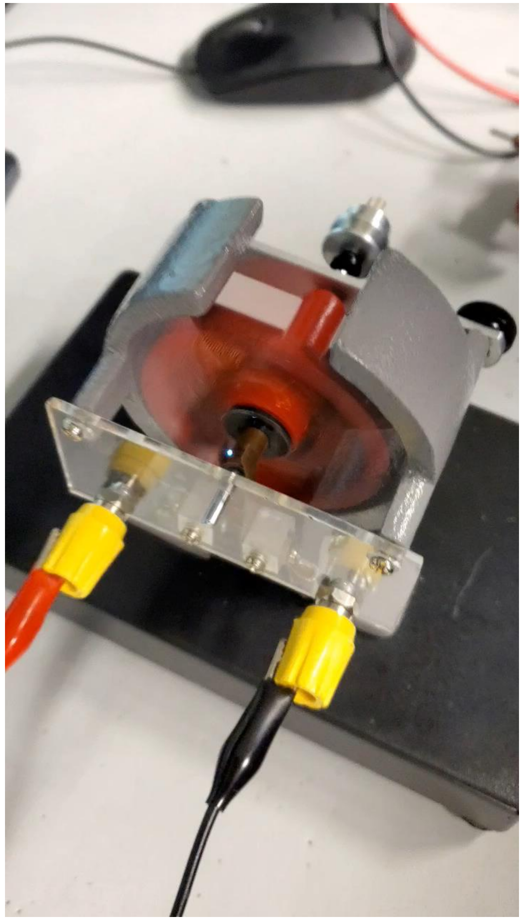
2 Pole Armature



Lab 3 - Demo Electric Motor PH1237





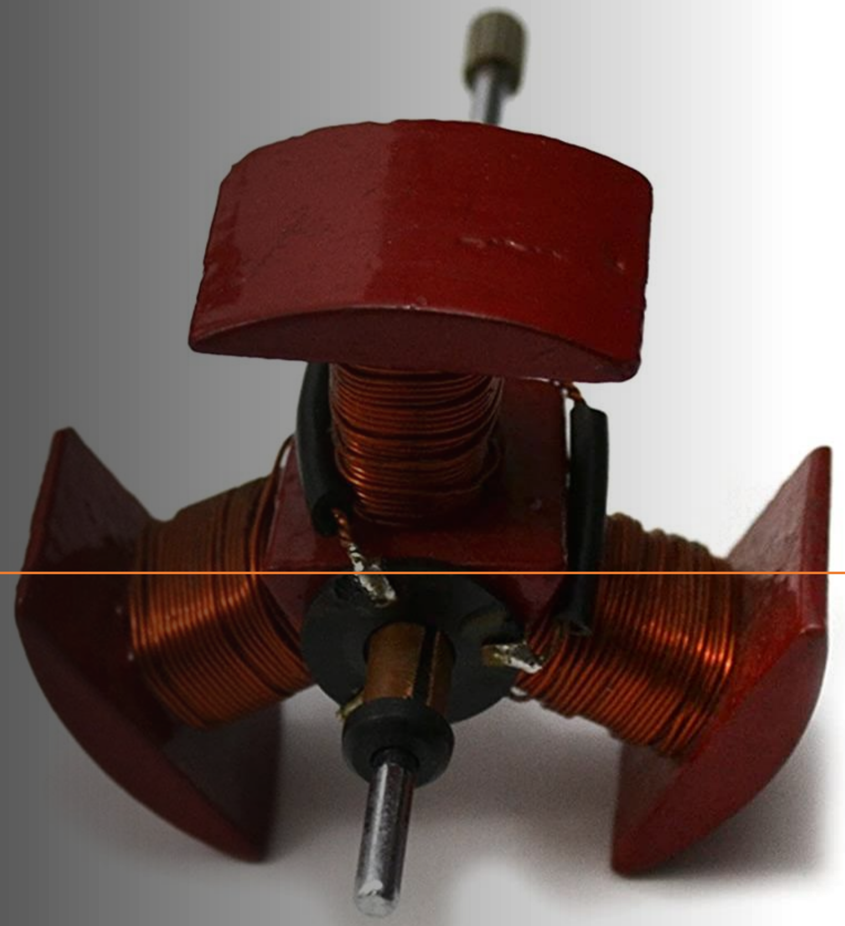


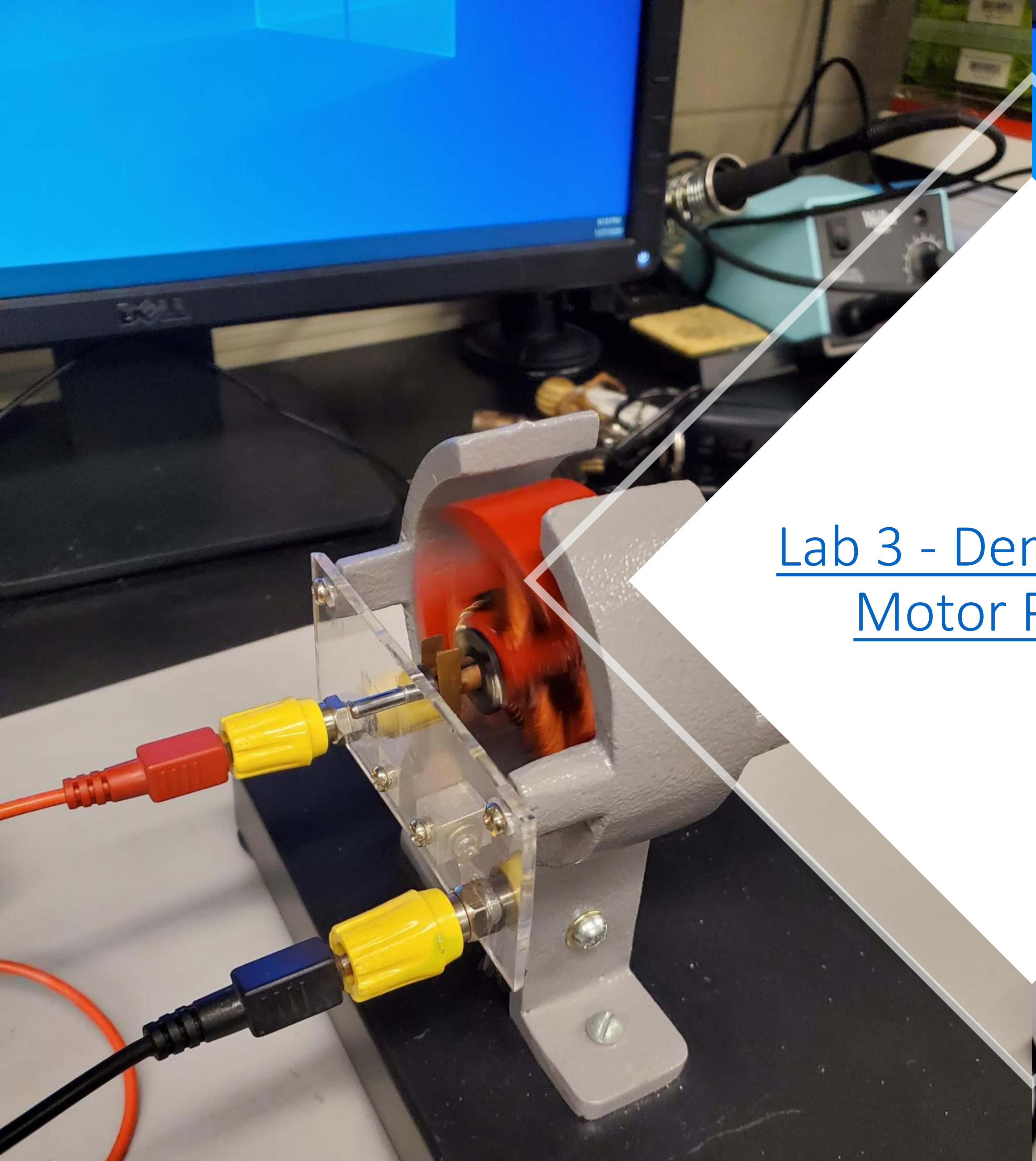
Observations

- Initially we started with the 2 pole, we did not know why it wasn’t working. I then decided to take off the 2 Pole and inspect it, I found one of the leads had broken off, I re soldered it and it functioned perfectly. We got 6v at 3amps.

Lab 3 - Demo Electric Motor PH1237

3 Pole Armature





Lab 3 - Demo Electric Motor PH1237

Observations

- It took a minimum of 1.7v to get movement to happen with the 3 pole armature installed. We tested at 1.5v at got no movement.

Lab 3 - Demo Electric Motor PH1237

4 Pole Armature

Observations

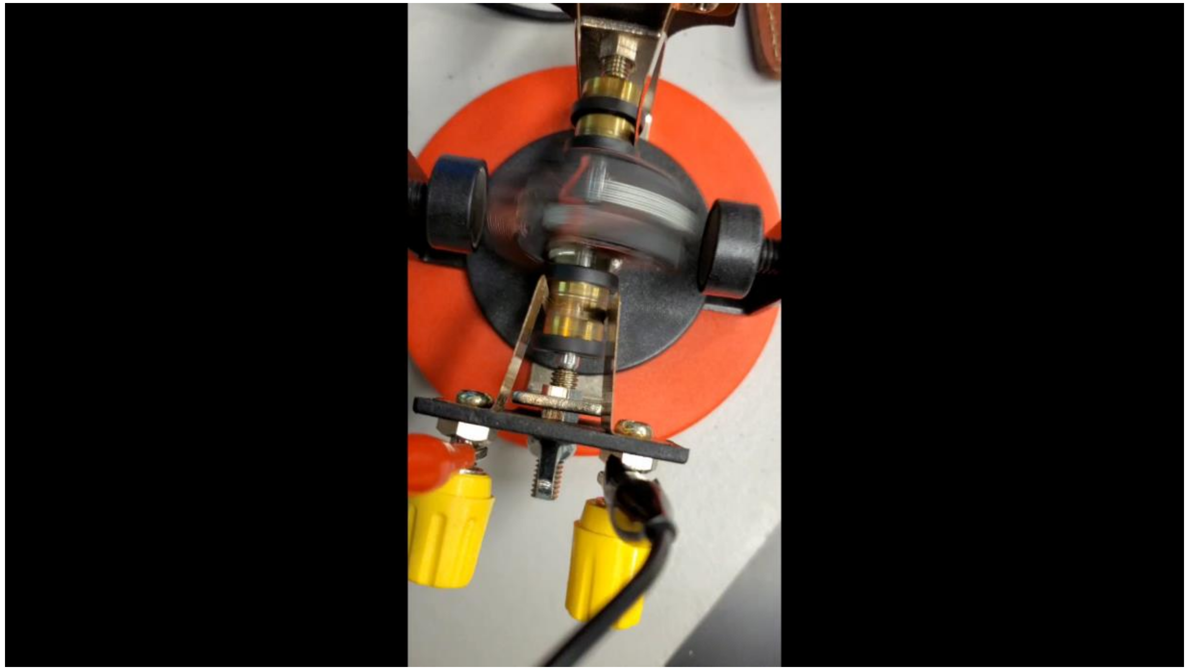
- With the 4 pole it took minimum of 2.8v to get the armature to start rotating

Lab 4 - EISCO Motor Generator

Equipment needed

- Eisco motor generator
- Power supply
- multimeter

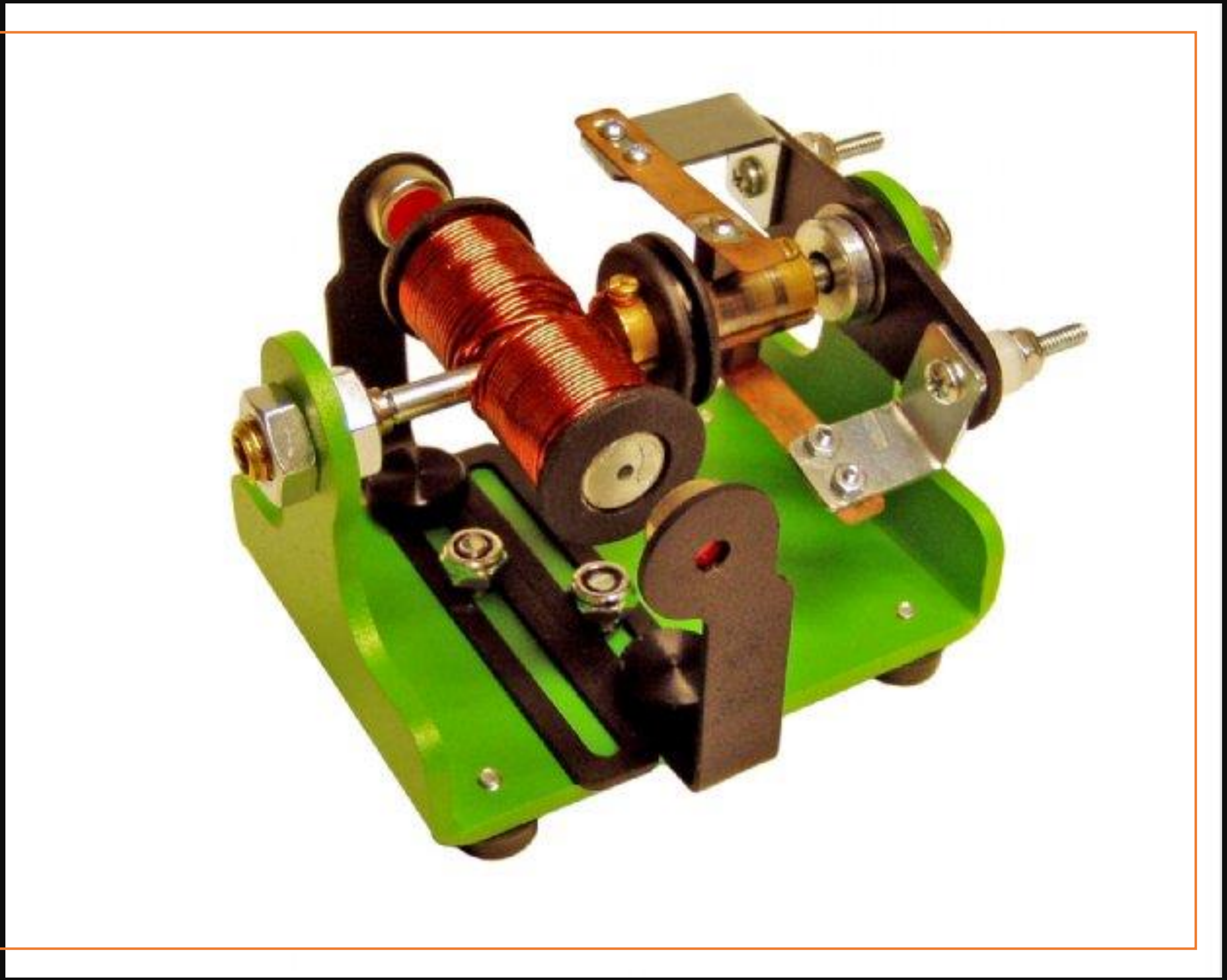
Lab 4 - EISCO Motor Generator

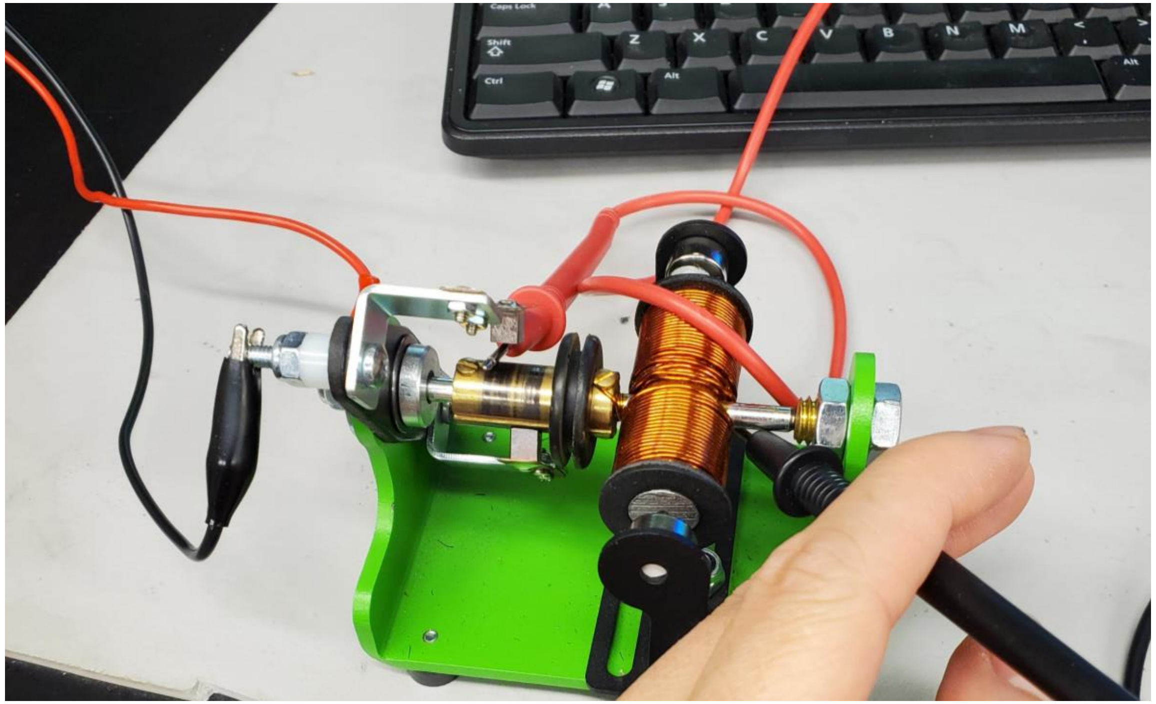


Observations

- The closer I moved the magnets on both sides the more torque was being generated per rotation, I was also able to control the speed by moving the magnets closer or further from the center just from experimenting I had found there to be a sweet spot as far as distance is concerned in correlation to the center for best efficiency

Lab 5 - St Louis motor





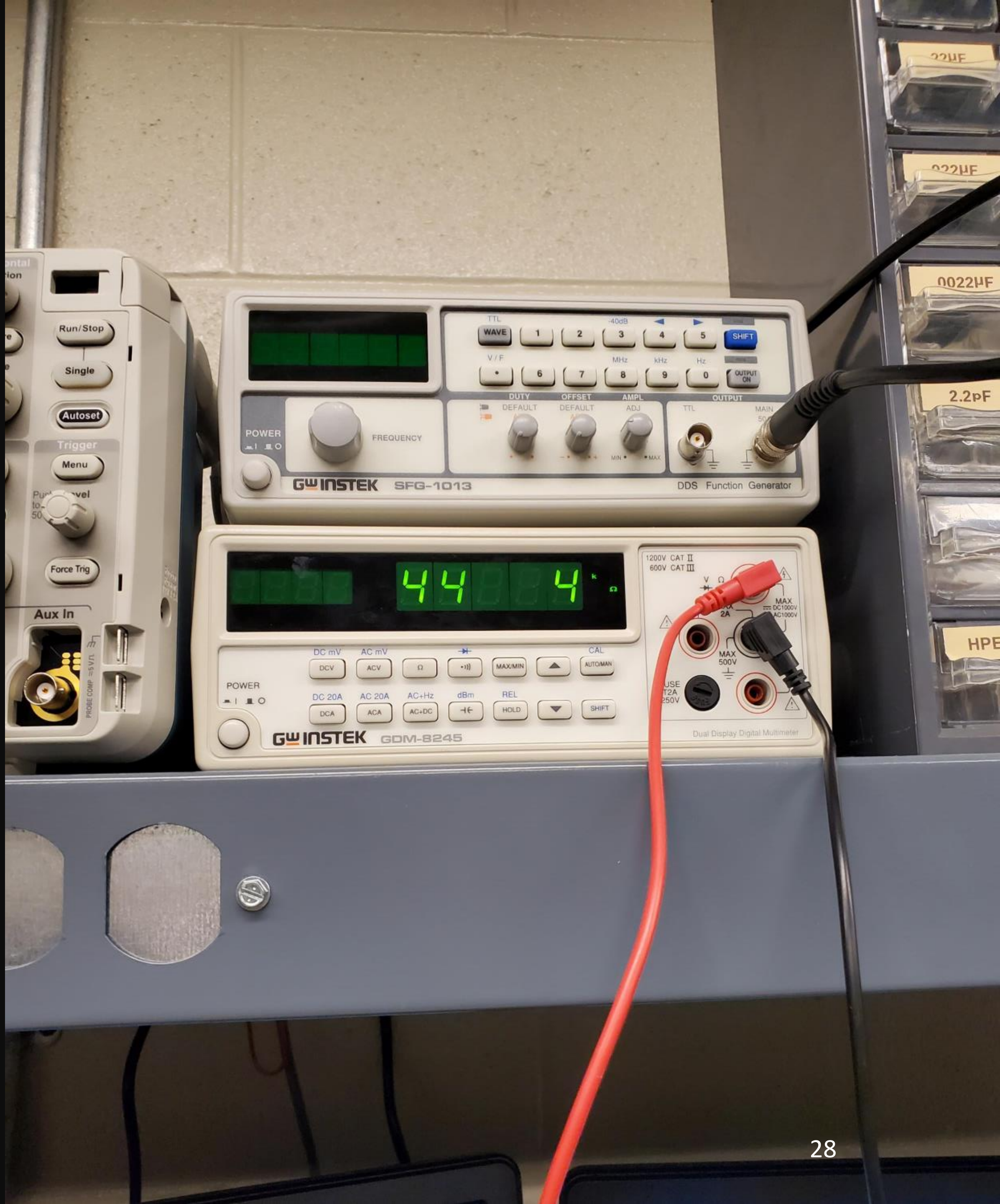
Lab 5 - St Louis motor

Equipment needed

- St. louis motor
- Power supply
- multimeter

Observations

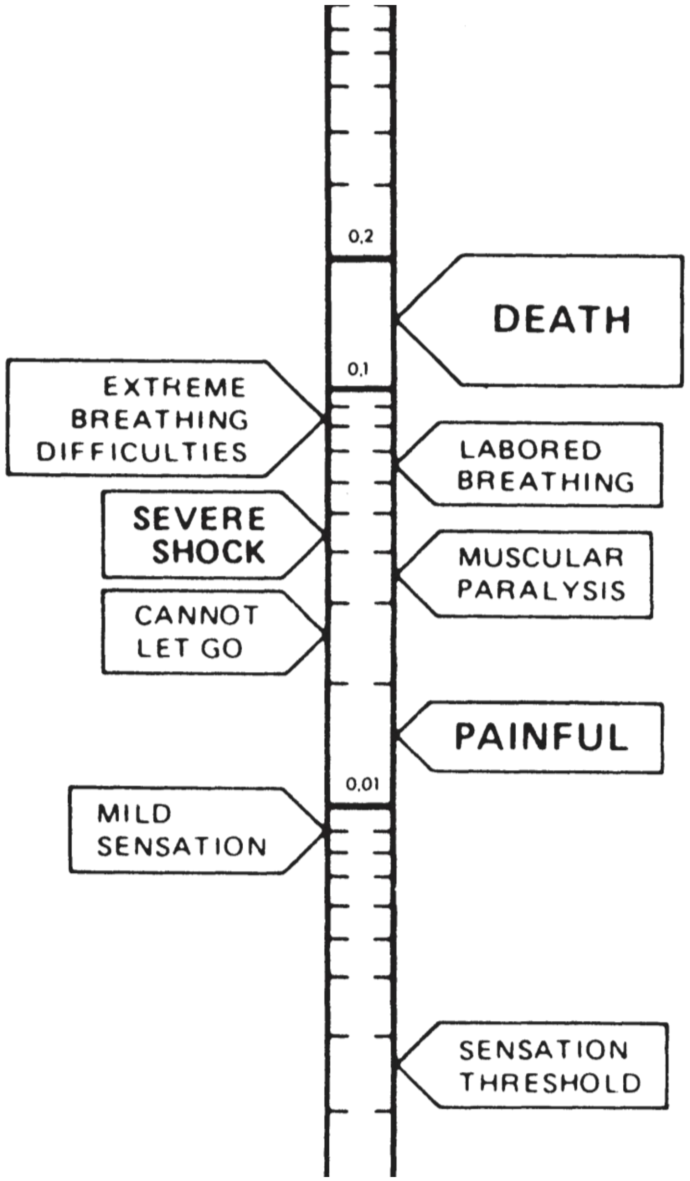
- We decided to measure the resistance of the coils and it was 445.34KOhms
- The measurements we got were 1.75-1.84 amp/4.5-5.1v



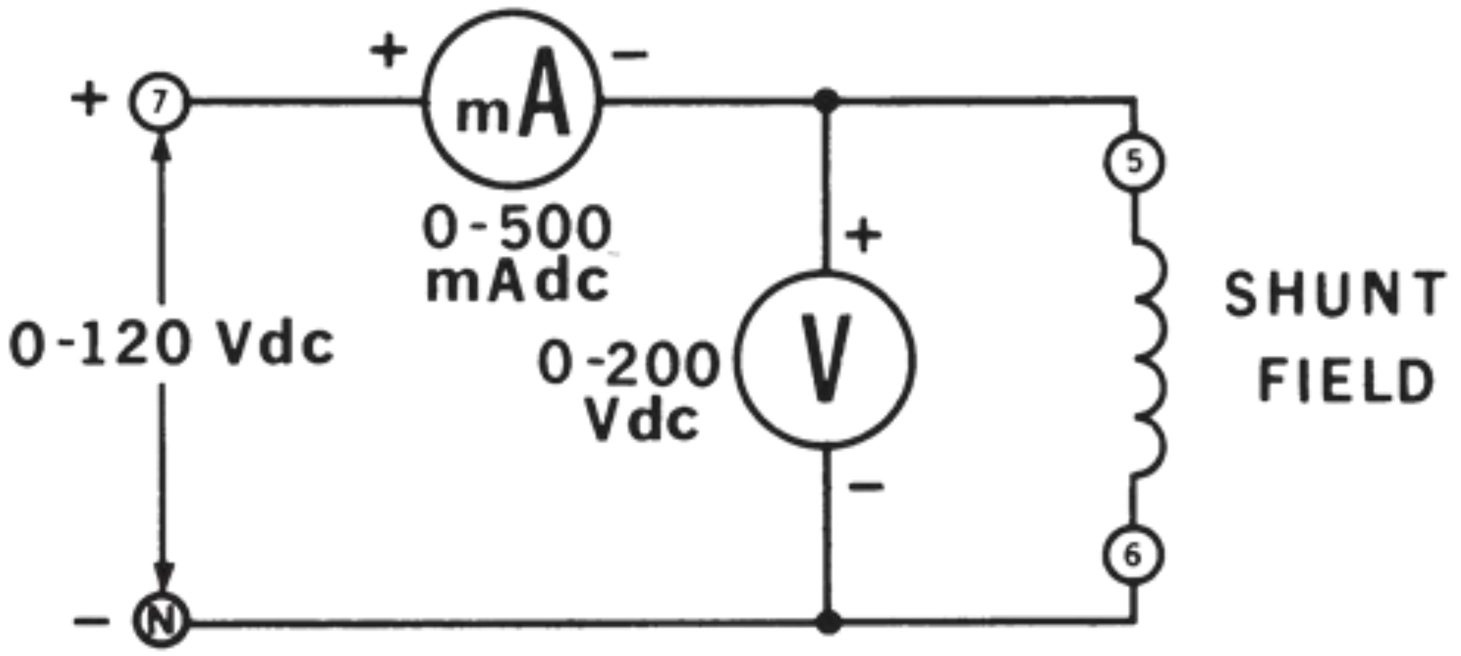
Lab Volt Section

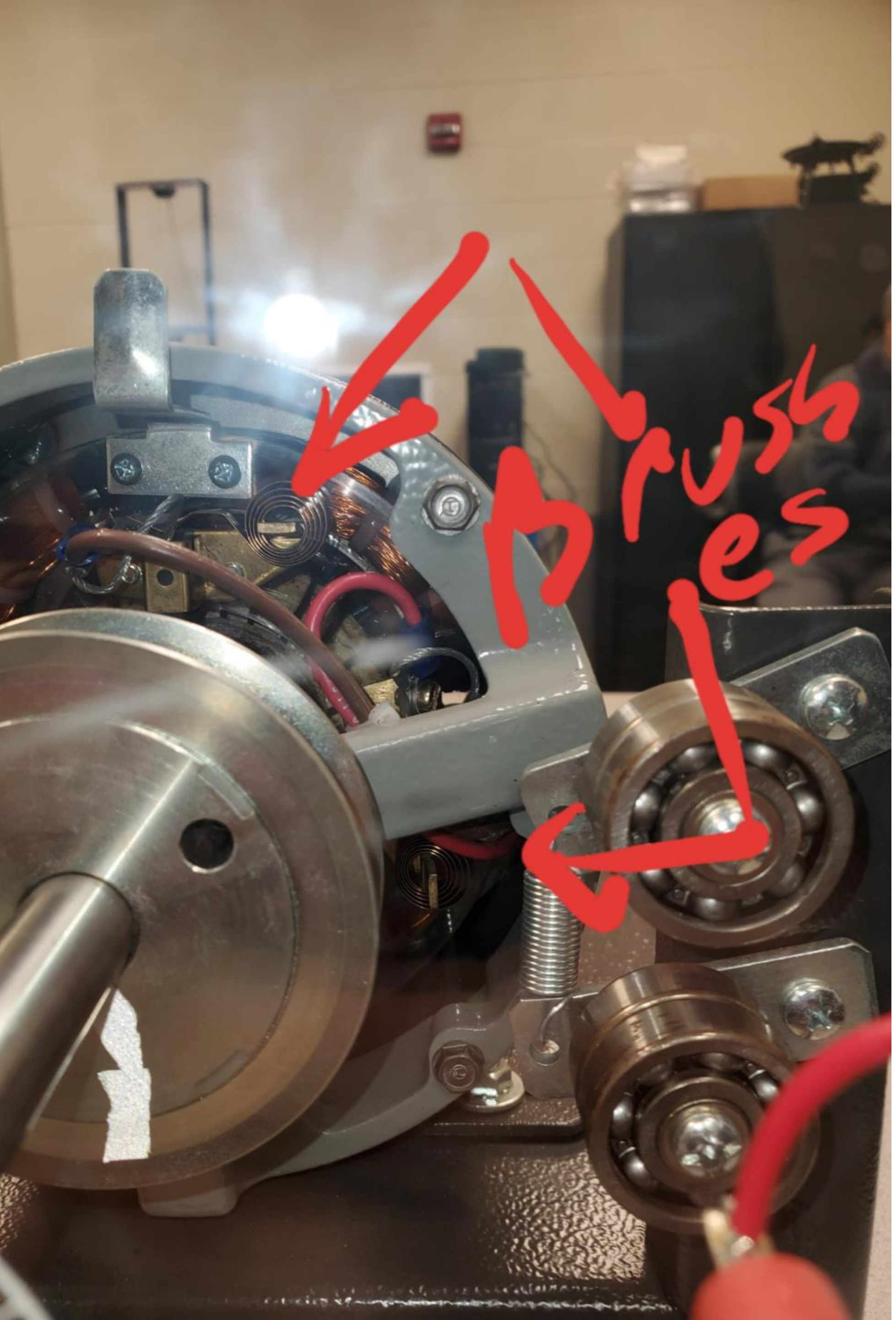
Lab volt safety

- As you can see, it is the current that determines the intensity of an electrical shock. Currents above 100 mA are considered fatal. A person who has received a shock of over 2000 mA is in grave danger and needs immediate medical attention. Currents below 100 mA are still serious and painful. As a safety rule: Do not put yourself in a position where you could receive any kind of shock, no matter how low the current is.



Experiment 11 - Direct Current Motor - Part I





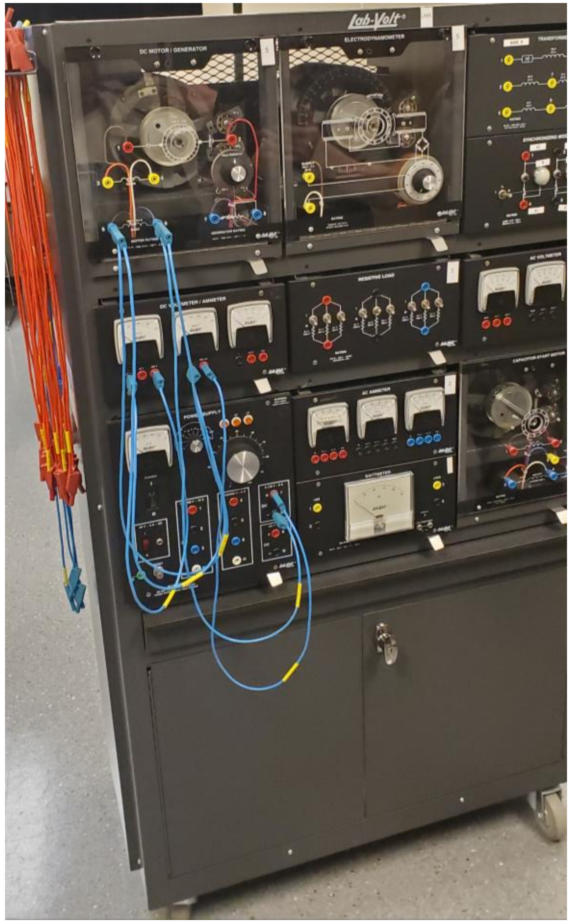
Objective

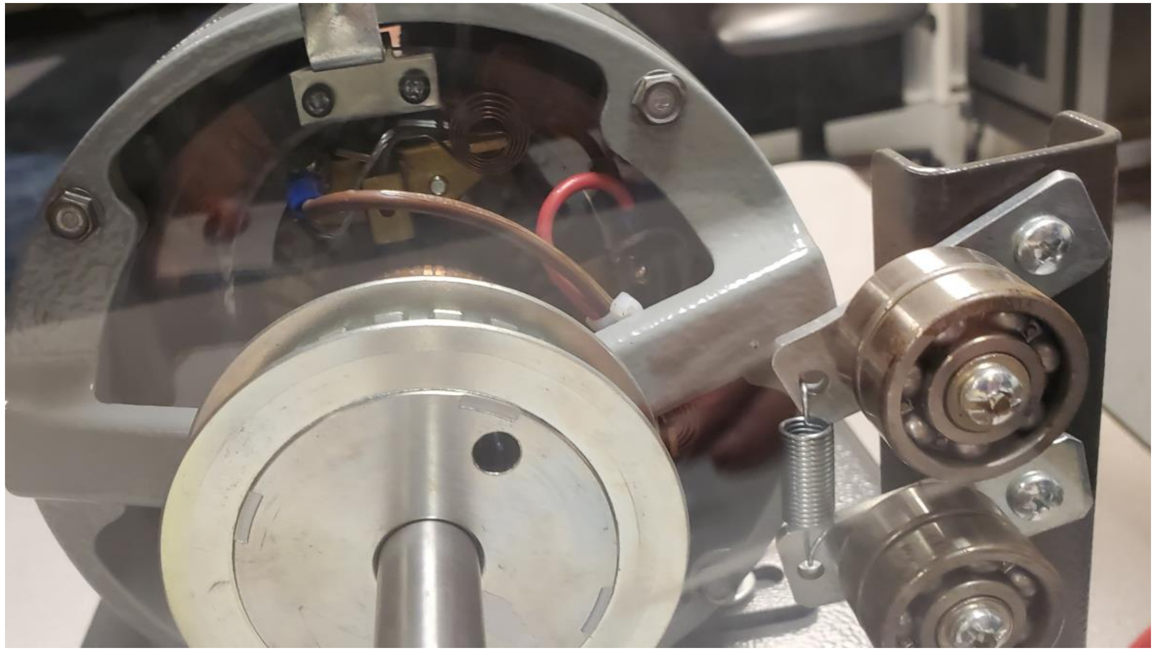
- **OBJECTIVE**
- To examine the construction of a DC motor / generator.
- To measure the resistance of its windings.
- To study the nominal current capabilities of the various windings.

Equipment needed

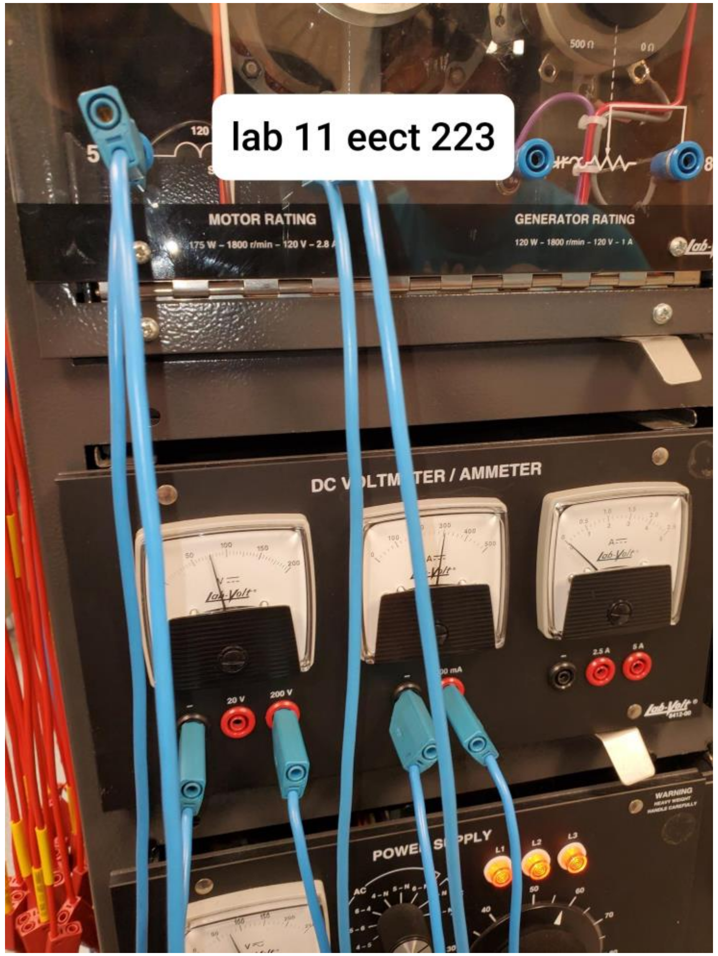
- 8110- Mobile Workstation
- 8211- DC Motor/Generator
- 8311- Resistive Load
- 8412- DC Voltmeter/Ammeter
- 8821- Power Supply
- 8951- Connection Leads

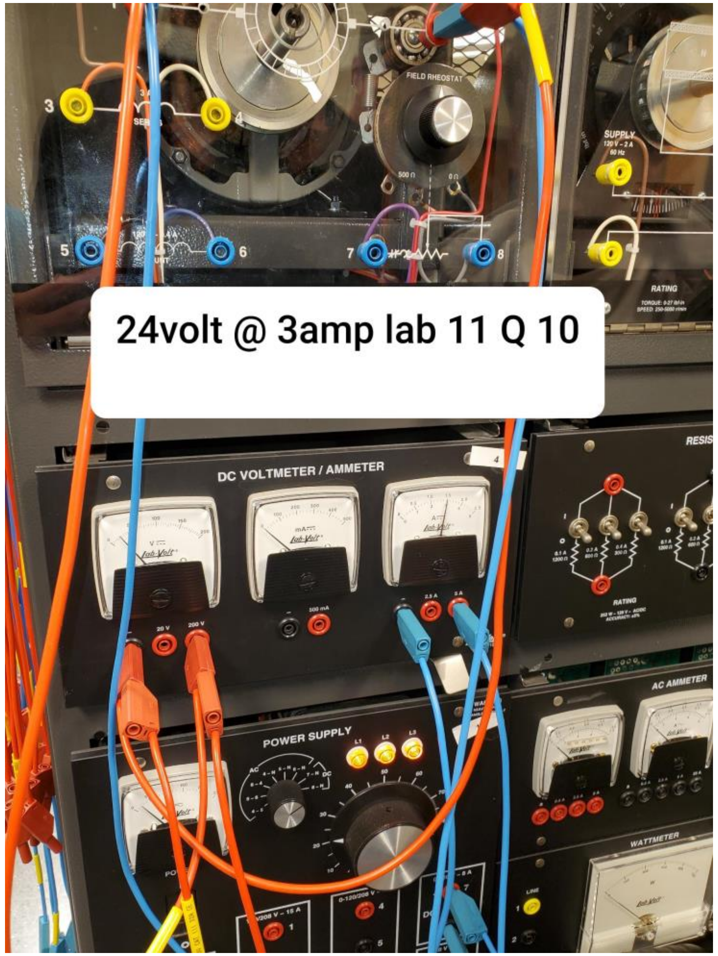
Experiment 11 - Direct Current Motor - Part I



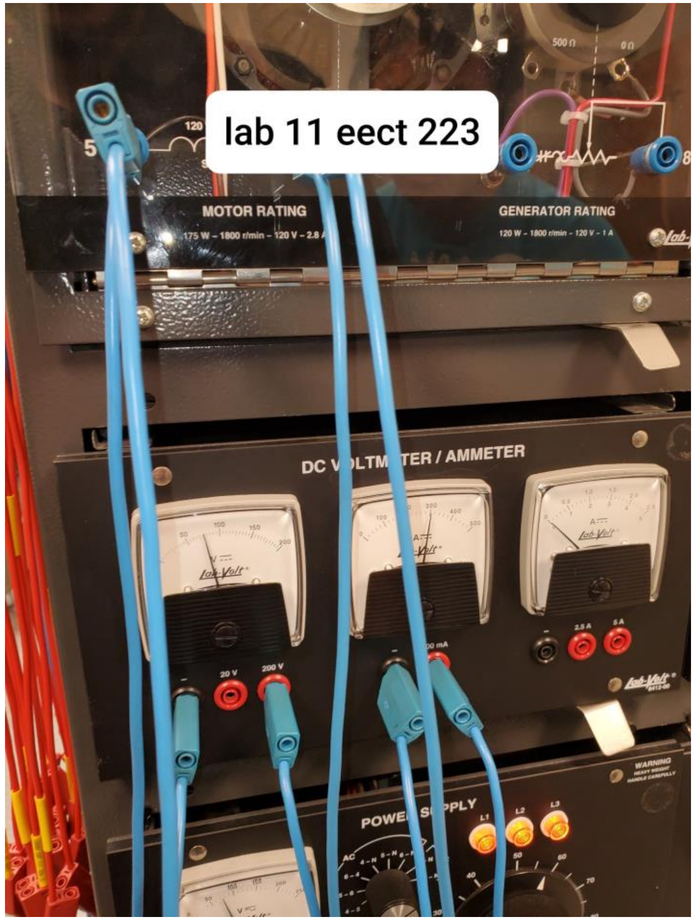


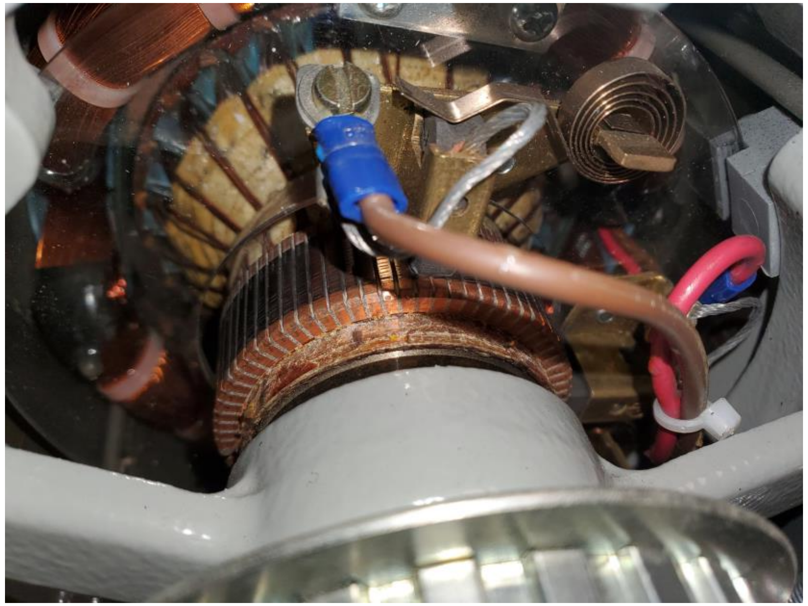
Lab 11

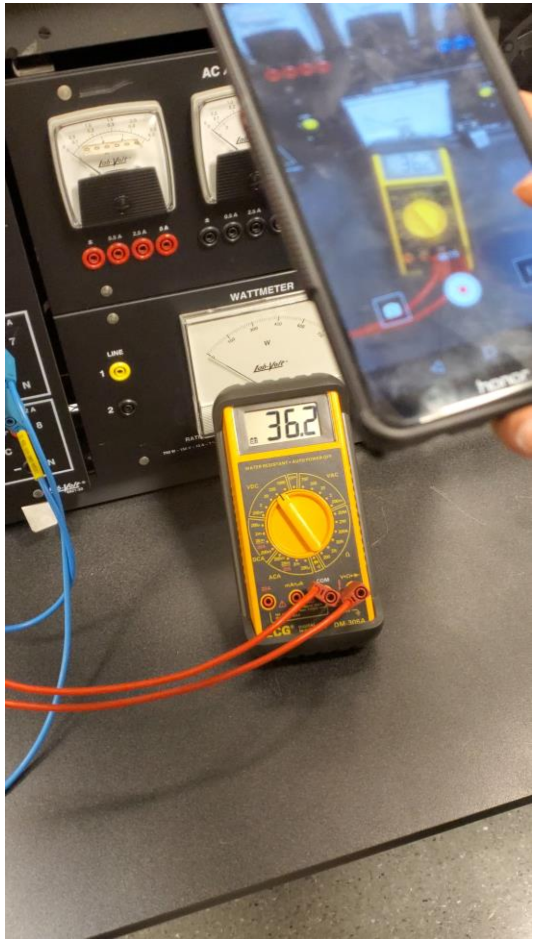

lab 11 eect 223
MOTOR RATING
GENERATOR RATING
DC VOLTMETER / AMMETER


24volt @ 3amp lab 11 Q 10
DC VOLTMETER / AMMETER
POWER SUPPLY
AC AMMETER
WATTMETER

Experiment 11 - Direct Current Motor - Part I







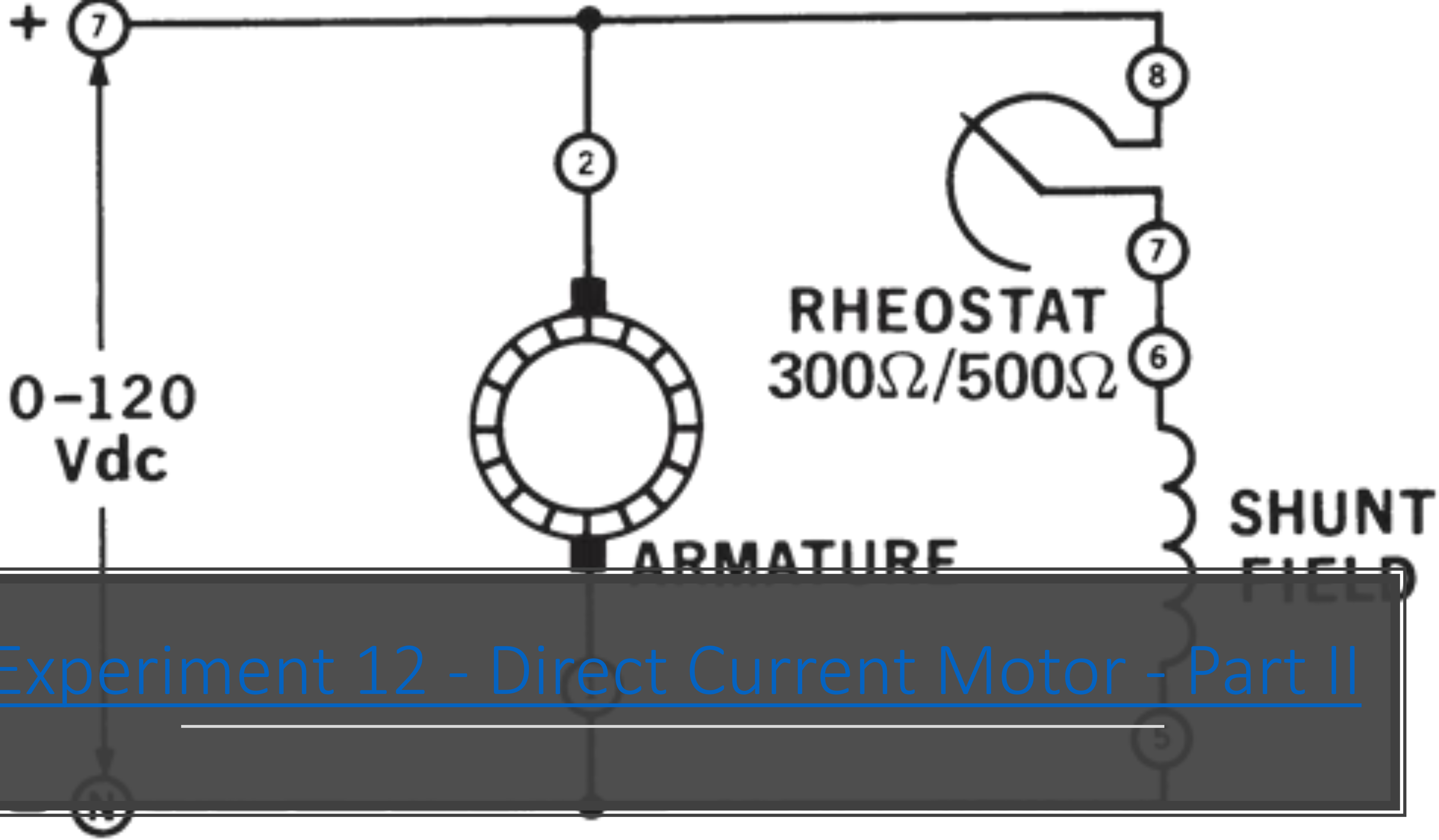
Click Play ->

Lab 11 DC motor specs

- Motor Output Power 175 W
  Generator Output Power 120 W
  Armature Voltage 120 V dc
  Shunt Field Voltage 120 V dc
  Full-Load Speed 1800 r/min
  Full-Load Motor Current 2.8 A
  Full-Load Generator Current 1 A
  Physical Characteristics
  Dimensions (H x W x D) 308 x 287 x 445 mm (12.1 x 11.3 x 17.5 in)
  Net Weight 14.1 kg (31 lb)

Observations for lab 11

- After reviewing the safety documents about using the labvolt, we assembled the workstation according to the labs and the dc motor started to rotate once we connected everything. We observed that the motor was whining and that it might need maintenance, we did not have a control machine to base our reading off of. For lab 11 we got alittle over 40 volts for 1.4 amps. Also that it was rated for 3 amps. But we were only able to get it up to about 1.5 amps max.



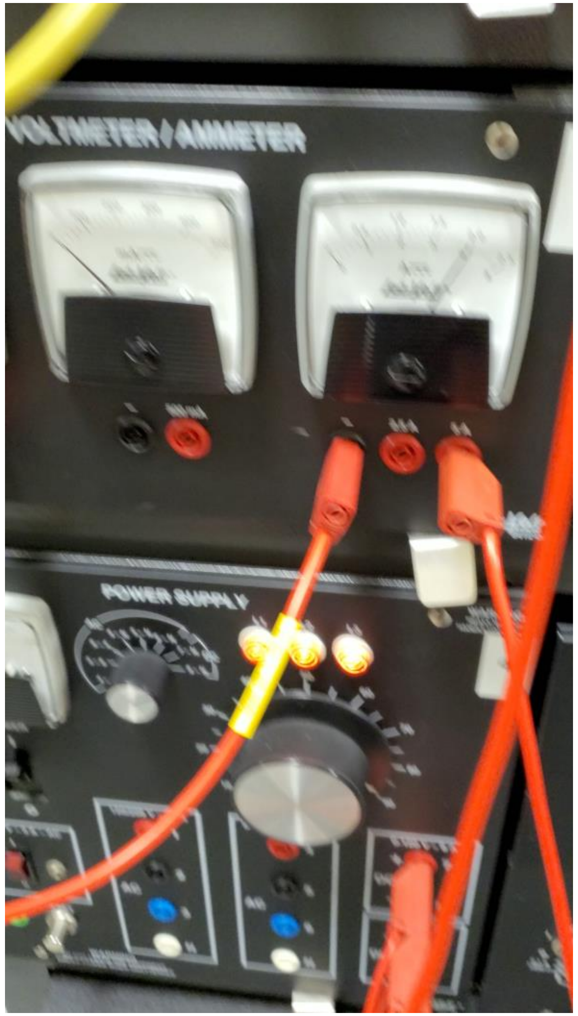
Experiment 12 - Direct Current Motor - Part II

Objective

- **OBJECTIVE**
- To locate the neutral brush position.
- To learn the basic motor wiring connections.
- To observe the operating characteristics of series and shunt connected motors.

Equipment needed

- 8110- Mobile Workstation
- 8211- DC Motor/Generator
- 8311- Resistive Load
- 8412- DC Voltmeter/Ammeter
- 8426- AC Voltmeter
- 8821- Power Supply
- 8920- Digital Tachometer
- 8951- Connection Leads

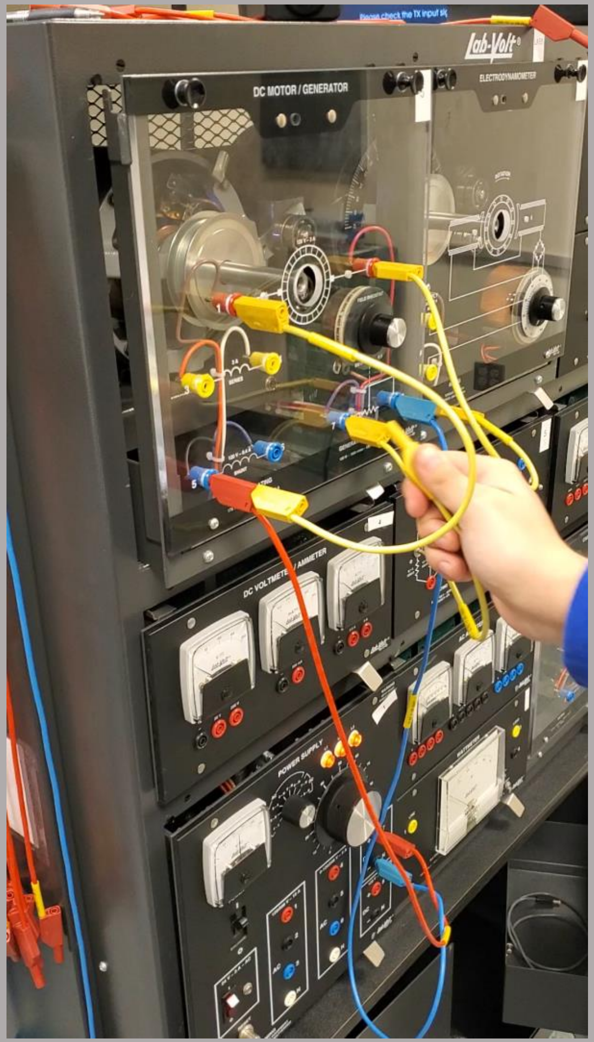


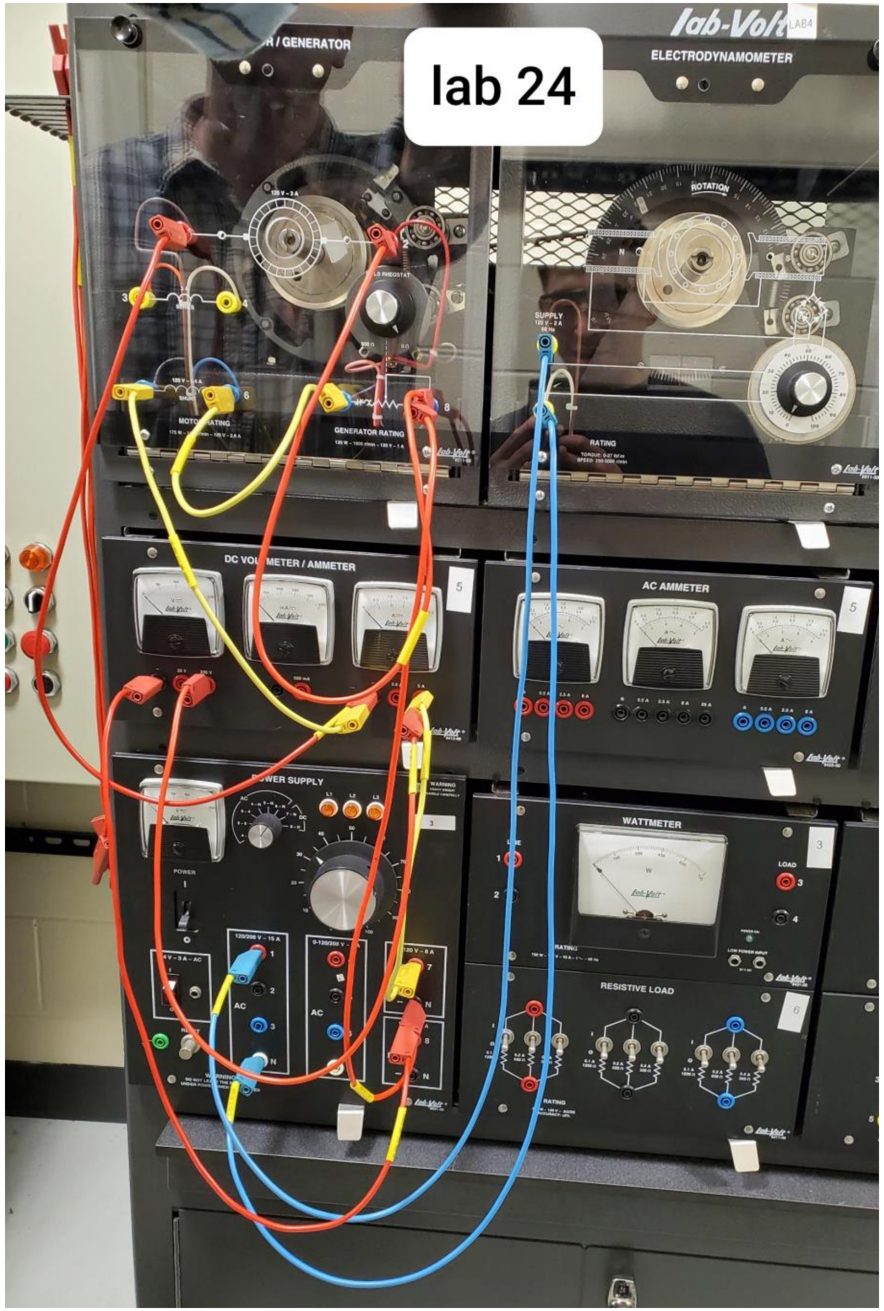
Experiment 12 - Direct Current Motor - Part II

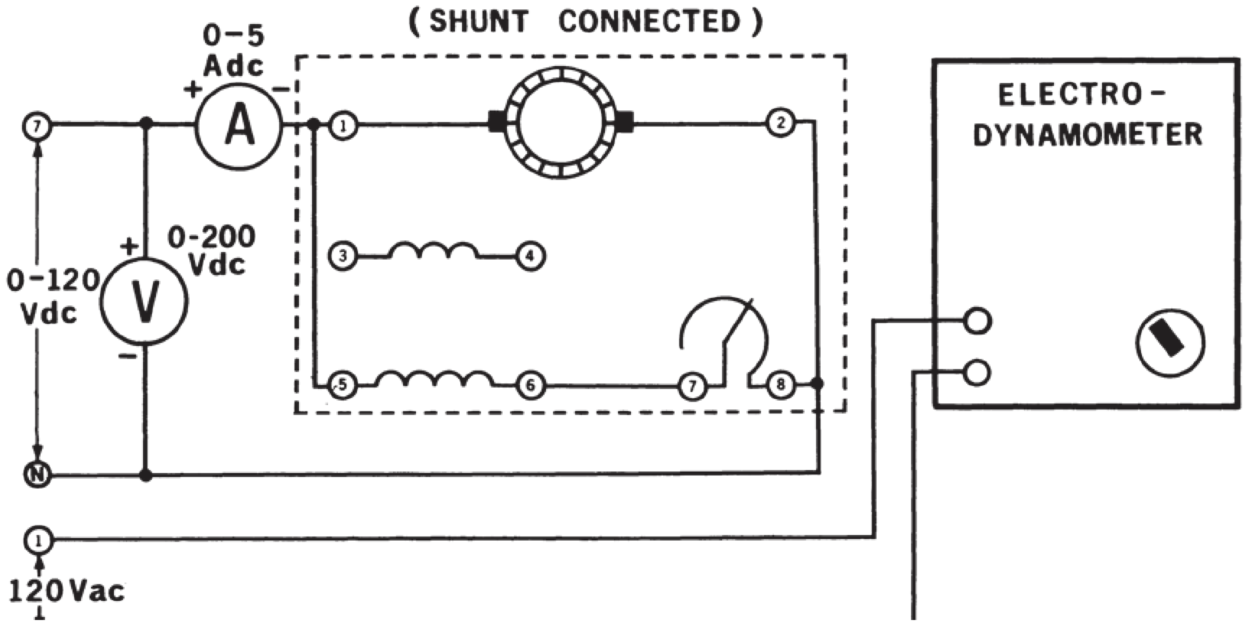
Video on top ^

Observations

- For lab 12 we had to read to learn the neutral brush position.
- The wiring process was much easier this time around after doing lab 11 as a large group with the whole class.







Experiment 24 - DC Shunt Motor

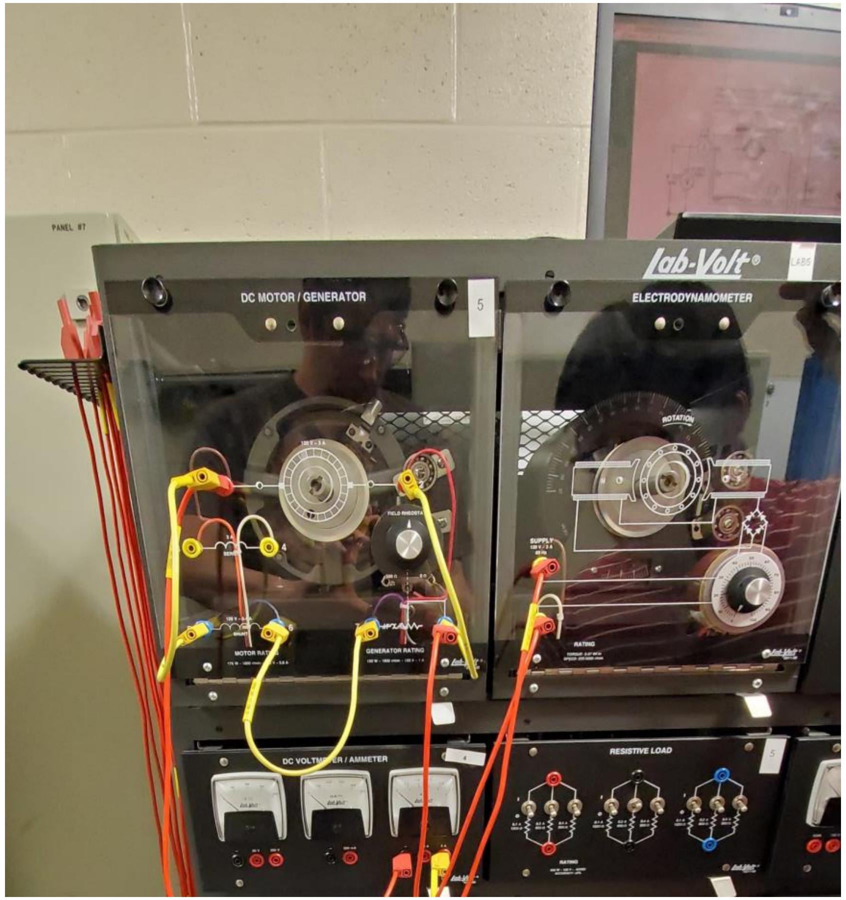
Objective

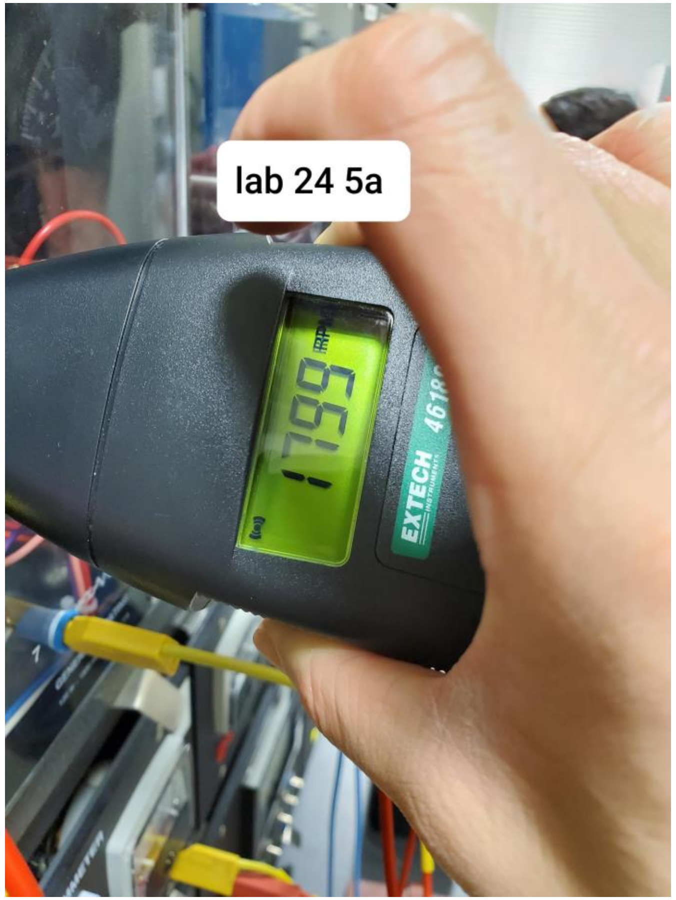
- **OBJECTIVE**
- To study the torque vs speed characteristics of a shunt wound DC motor.
- To calculate the efficiency of the shunt wound DC motor.

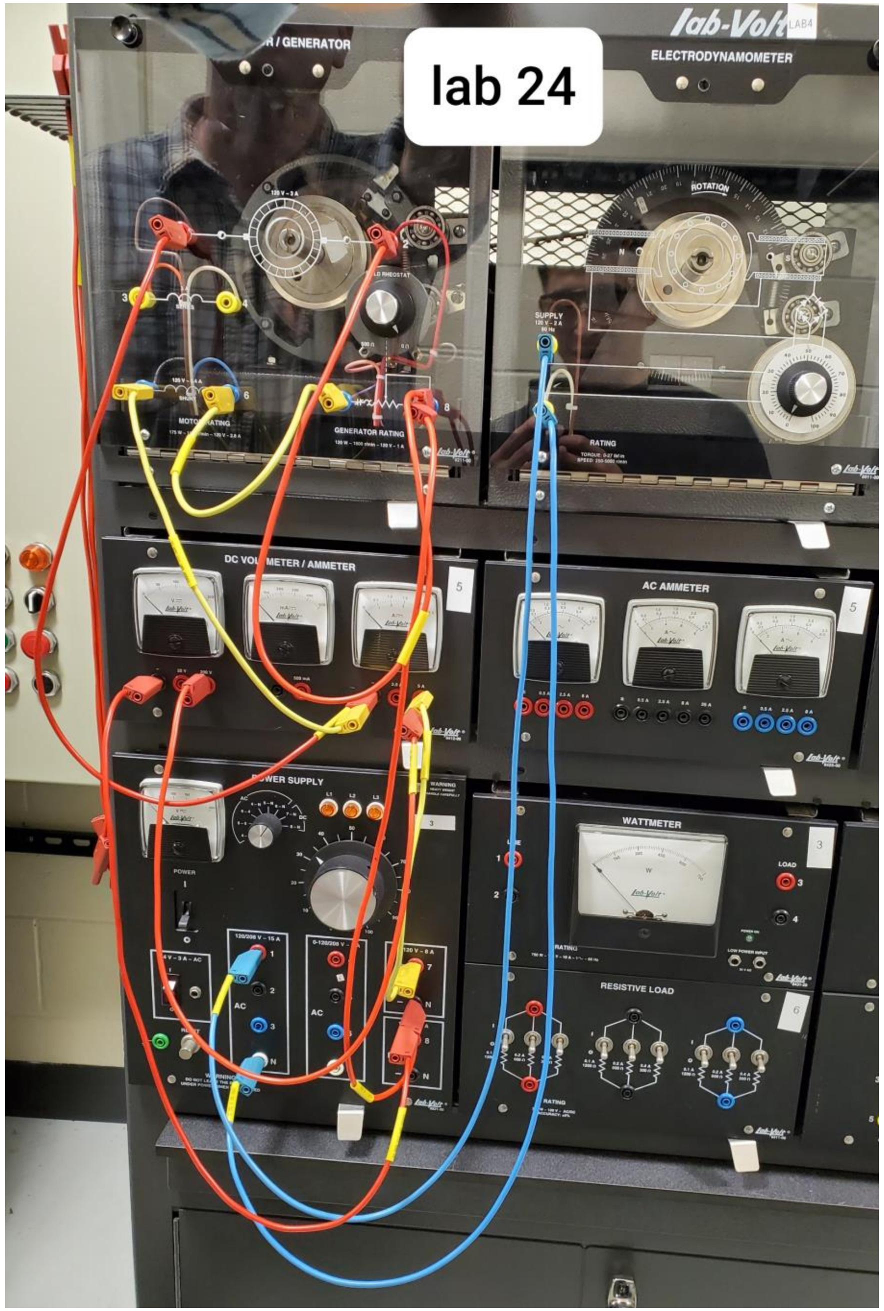
Equipment needed

- 8110- Mobile Workstation
- 8211- DC Motor/Generator
- 8241- Three-Phase Synchronous Motor/Generator
- 8412- DC Voltmeter/Ammeter
- 8821- Power Supply
- 8911- Electrodynamometer
- 8920- Digital Tachometer
- 8942- Timing Belt
- 8951- Connection Leads

Experiment 24 - DC Shunt Motor





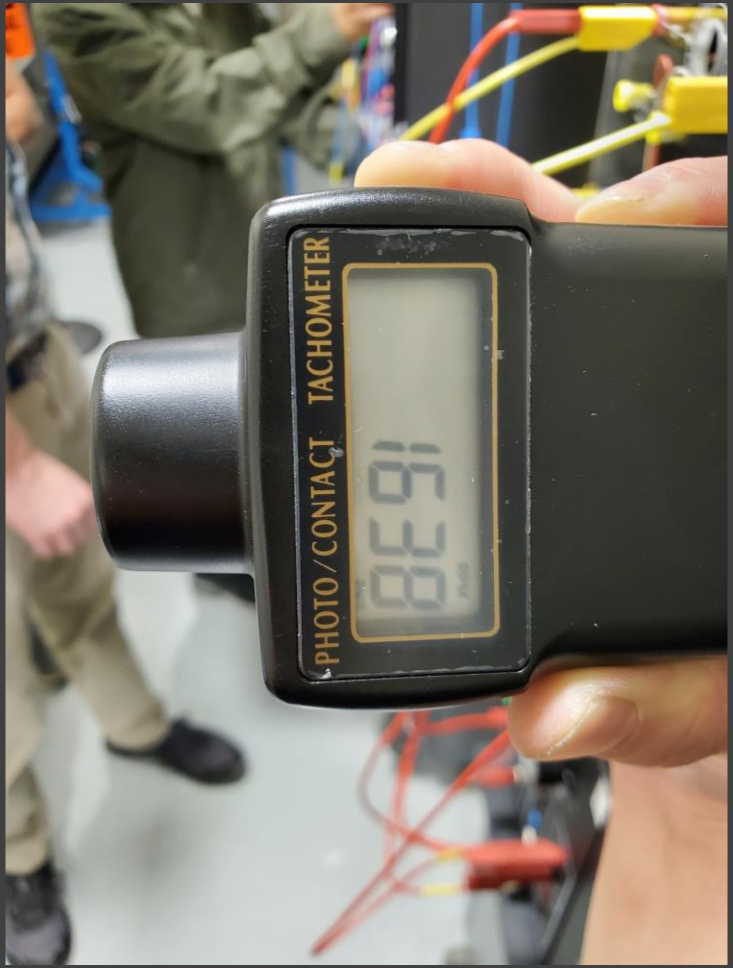


[Experiment 24 - DC Shunt Motor]

Experiment 24 - DC Shunt Motor

Click Play ->

Lab 24

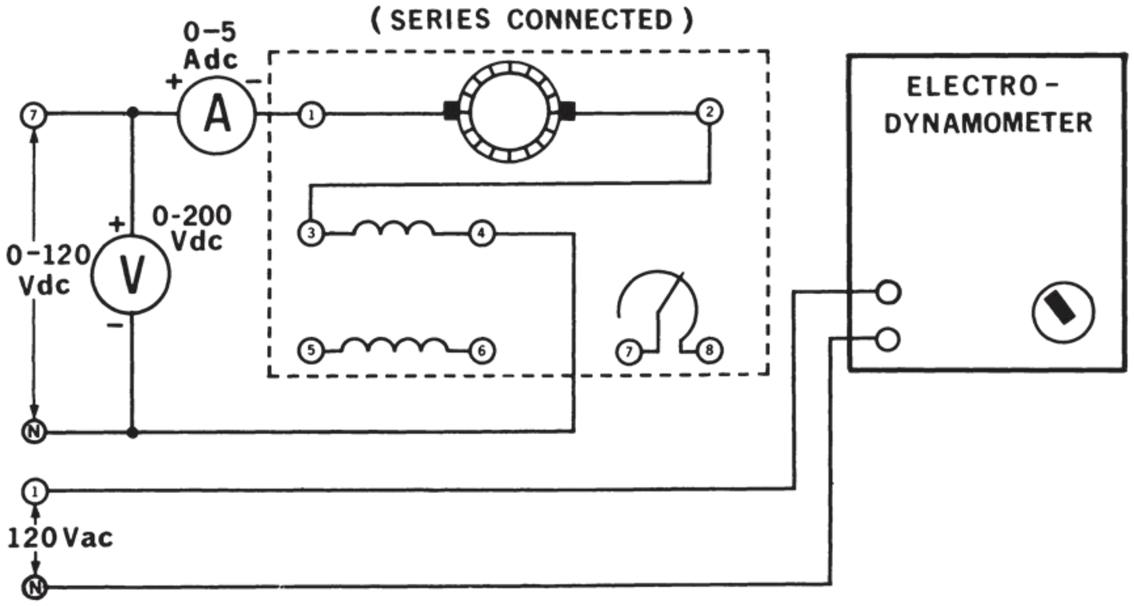


T	0	Pout(W)
t2	0.3	0
t3	0.6	0.008557
t4	0.9	0.015331
t5	1.2	0.021966
rpm1	1800	0.029078
rpm2	1794	
rpm3	1607	
rpm4	1535	
rpm5	1524	
i1	1.2	
i2	1.3	
i3	1.7	
i4	1.7	
i5	2	

Observations

- Intitially we got everything hooked up but our belt was not the correct length so we got another one. Then when we checked the tachometer for lab 24 and it was at 1799 rpm and 120v. But the reading corelate to our excel documents with acceptable figures. we did notice that the drop from rpm 2 and rpm3 had the most drop in rpm compared to the other torque applications in this lab

Experiment 25 - DC Series Motor

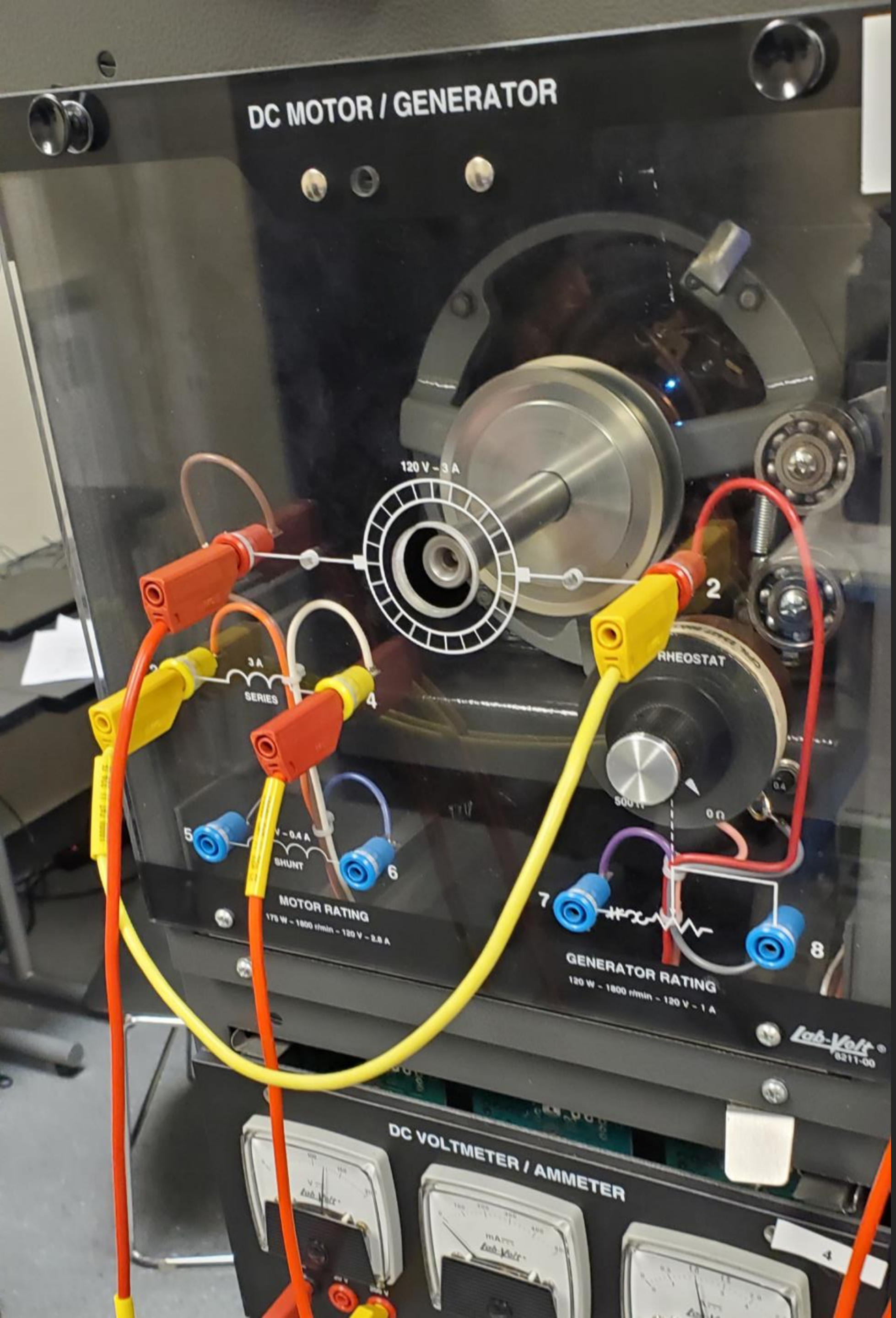


Objective

- **OBJECTIVE**
- To study the torque vs speed characteristics of a series wound DC motor.
- To calculate the efficiency of the series wound DC motor.

Equipment needed

- 8110- Mobile Workstation
- 8211- DC Motor/Generator
- 8412- DC Voltmeter/Ammeter
- 8821- Power Supply
- 8911- Electrodynamometer
- 8920- Digital Tachometer
- 8942- Timing Belt
- 8951- Connection Leads



Experiment 25 - DC Series Motor

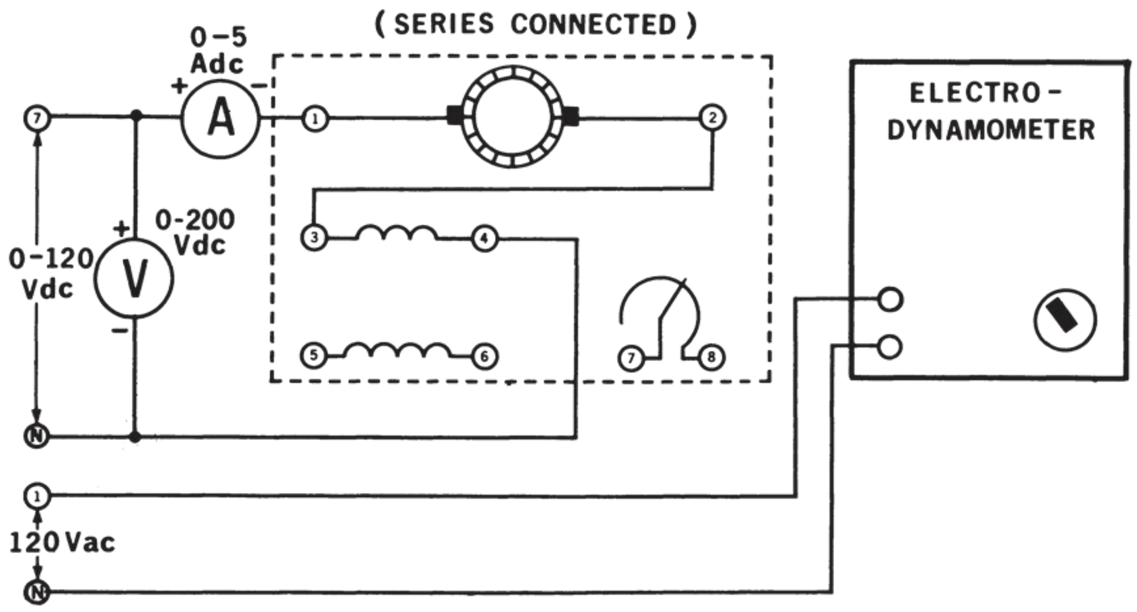
Lab 25

T	0	Pout(W)
t2	0.3	0
t3	0.6	0.007441
t4	0.9	0.014816
t5	1.2	0.022109
rpm1	1529	0.029288
rpm2	1560	
rpm3	1553	
rpm4	1545	
rpm5	1535	
i1	2.4	
i2	2.5	
i3	2.5	
i4	2.6	
i5	2.7	

Observations

- For lab 25 we noticed the more torque applied the slower the rpm got but the higher the current got. The reading were withing range of our excel sheet.

Experiment 26 - DC Compound Motor



Objective

OBJECTIVE

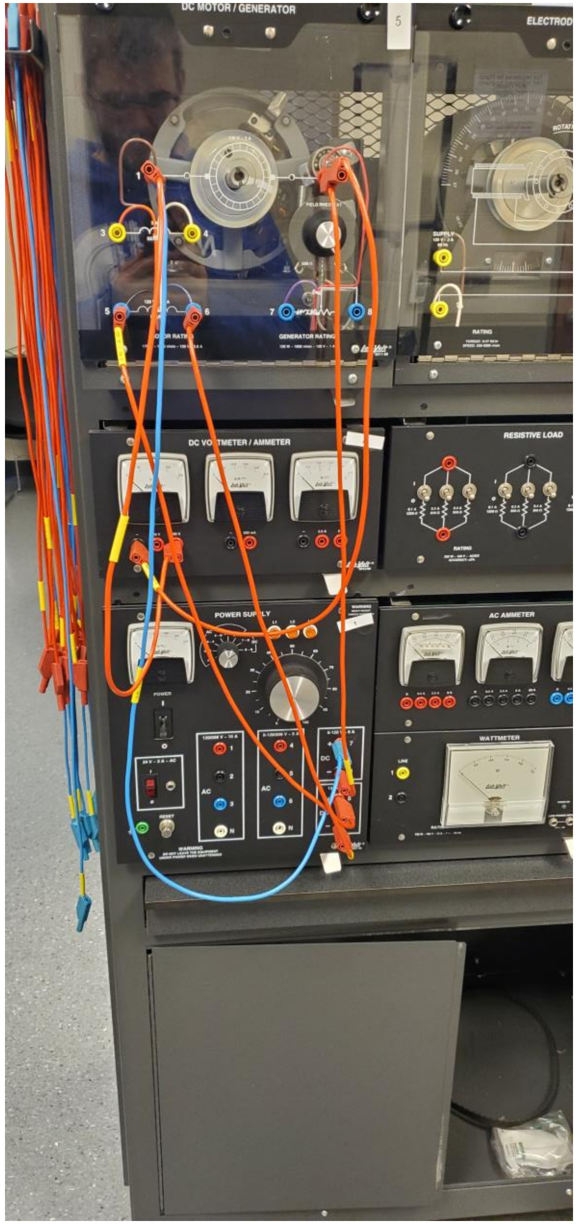
To study the torque vs speed characteristics of a compound wound DC motor.

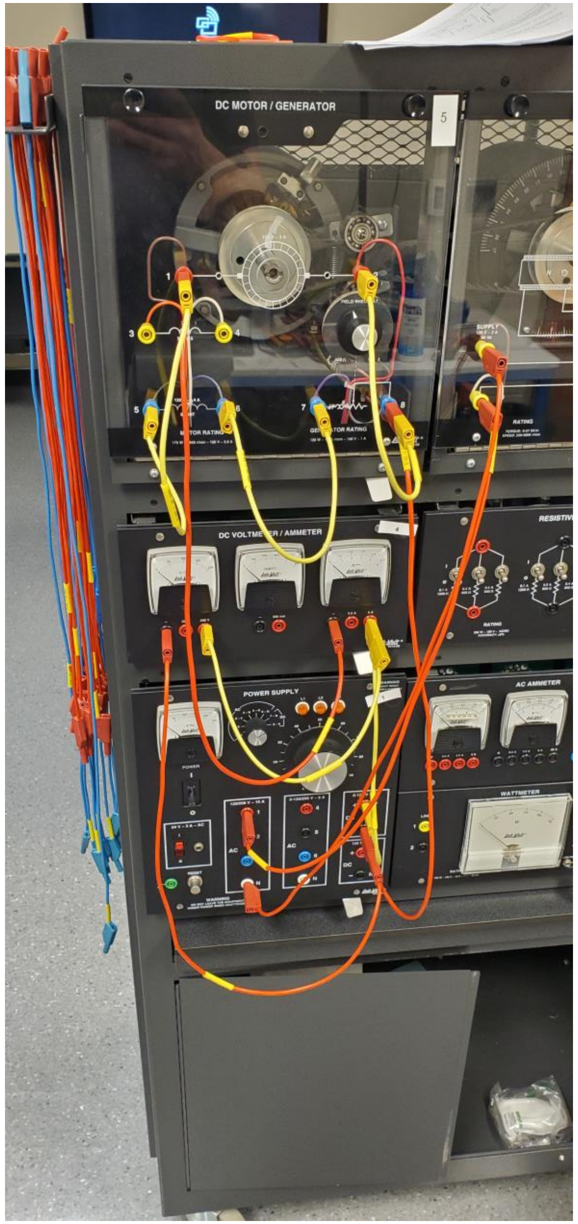
To calculate the efficiency of the compound wound DC motor.

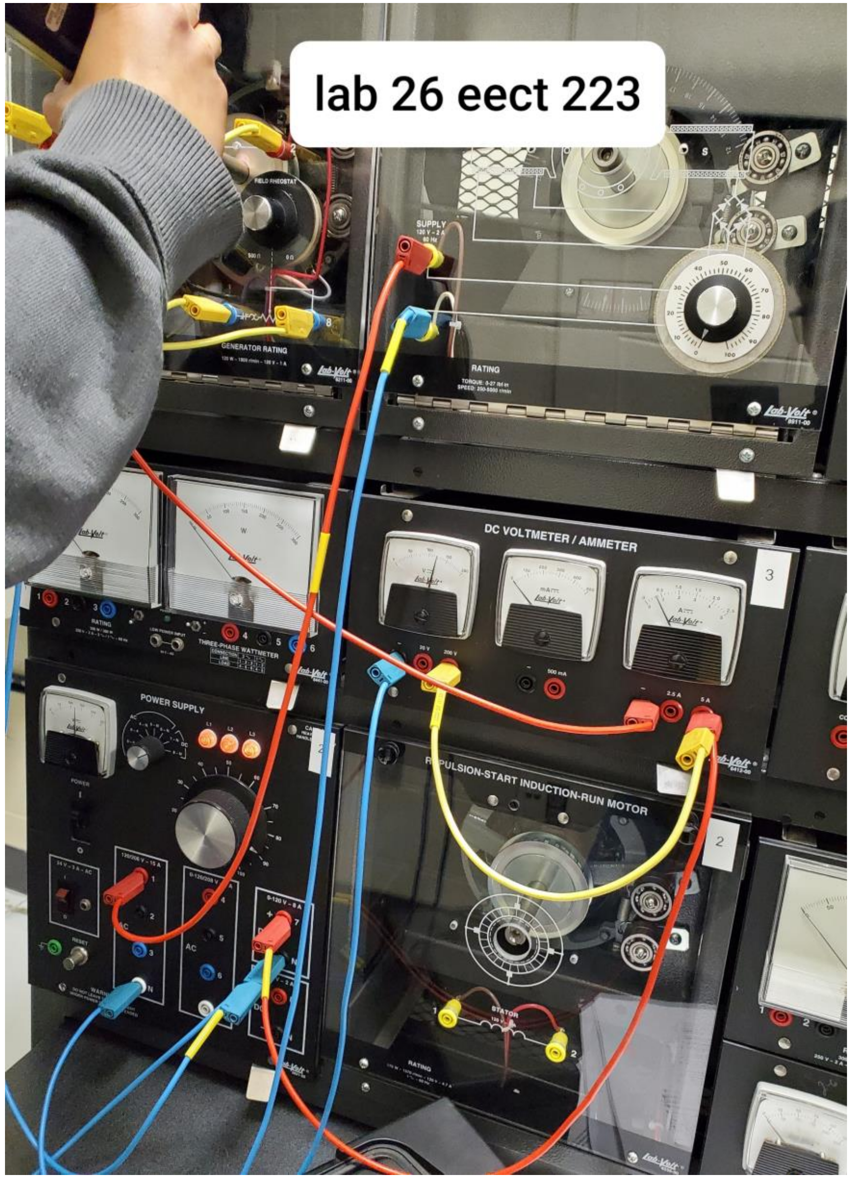
Equipment needed

- 8110- Mobile Workstation
- 8211- DC Motor/Generator
- 8412- DC Voltmeter/Ammeter
- 8821- Power Supply
- 8911- Electrodynamometer
- 8920- Digital Tachometer
- 8942- Timing Belt
- 8951- Connection Leads

[Experiment 26 - DC Compound Motor]

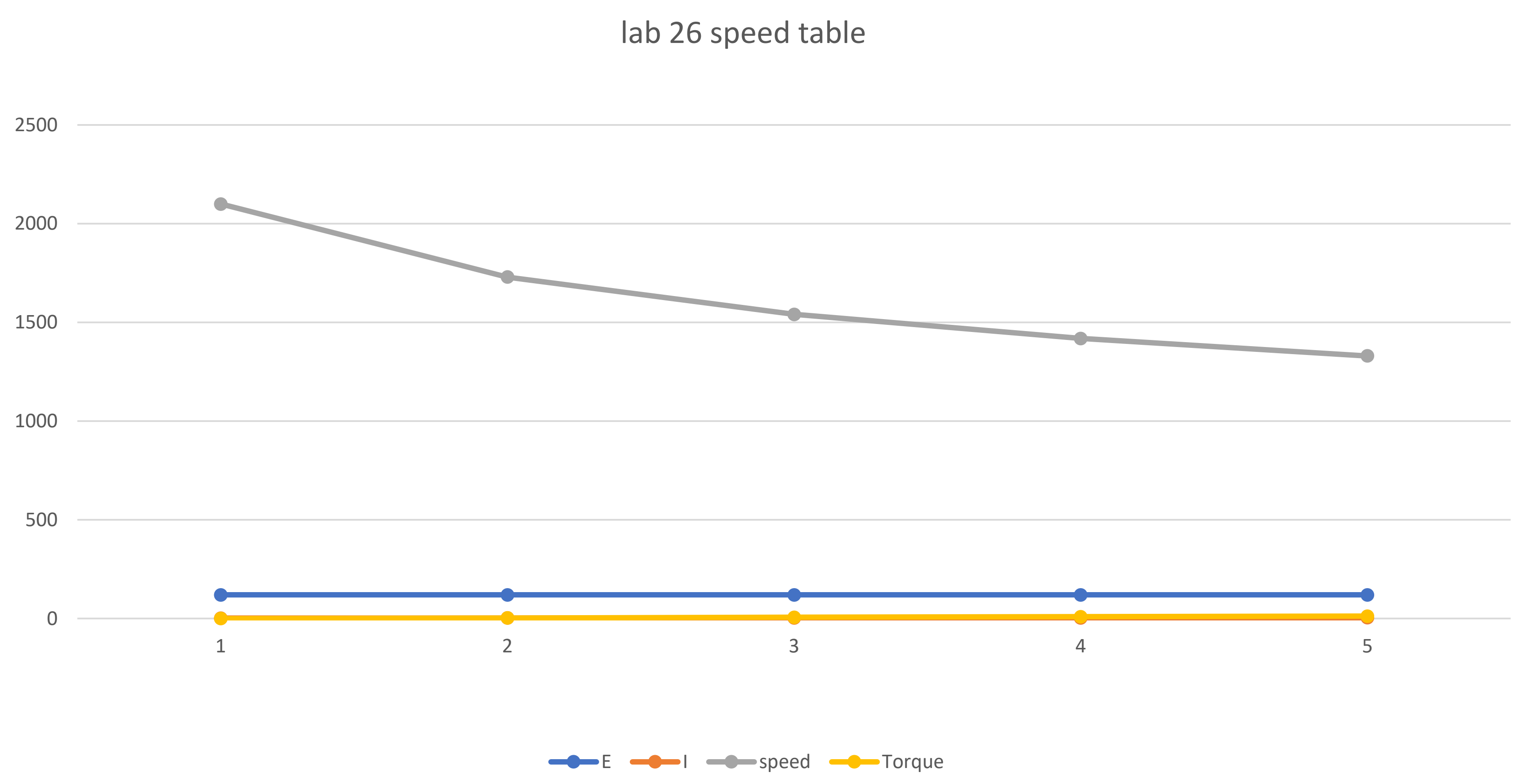






Experiment 26 - DC Compound Motor

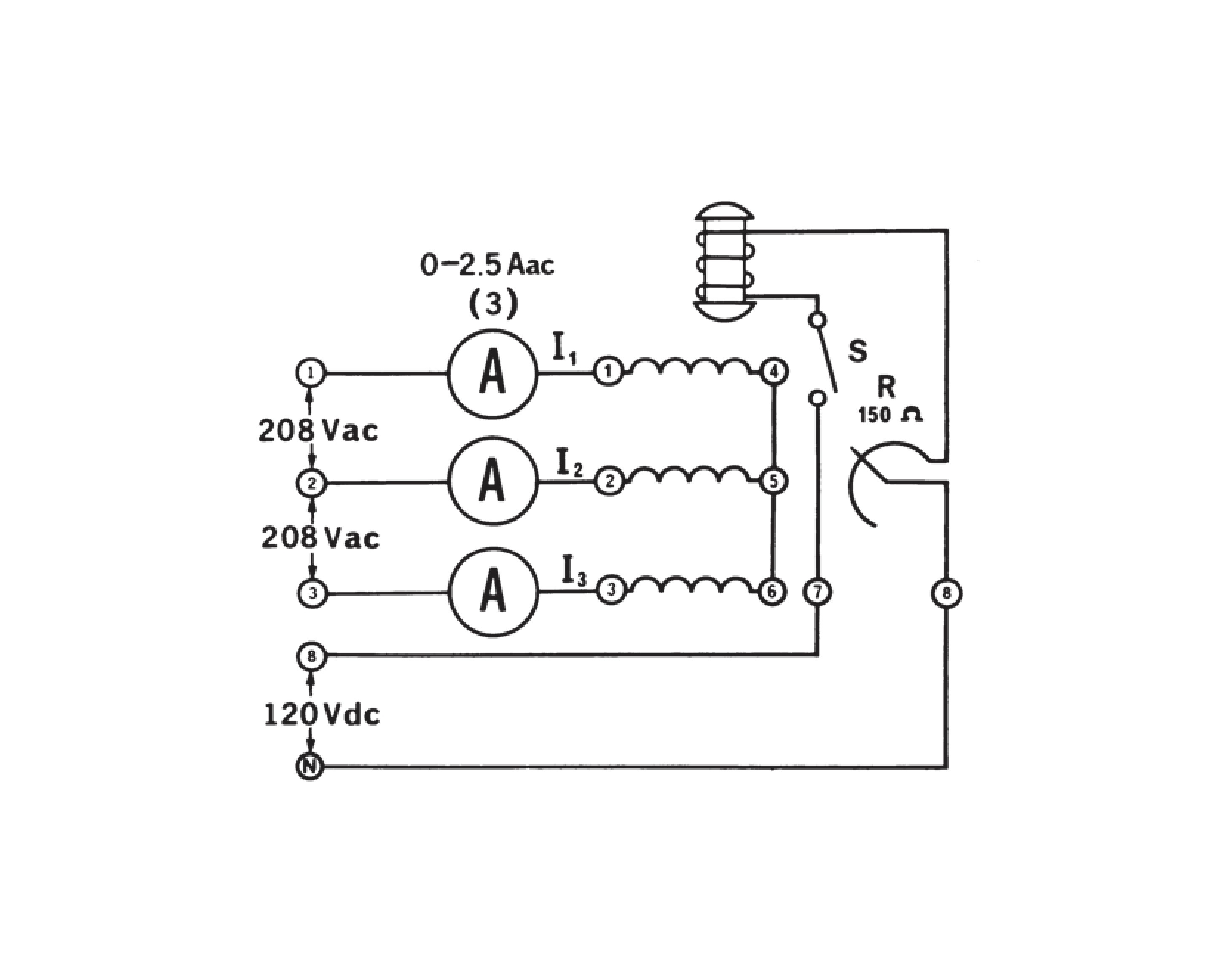
Lab 26



E	I	speed	Torque
120	1.9	2100	0
120	2.6	1730	3
120	3.1	1541	6
120	3.6	1419	9
120	4.1	1330	12

Observations

- The tachometer at our work station had a cracked head and we had to find another one. We noticed that it didn't take as much torque to get the motor to start running as it did with the previous dc motor lab volt labs.



Experiment 27 - DC Separately Excited Shunt Generator

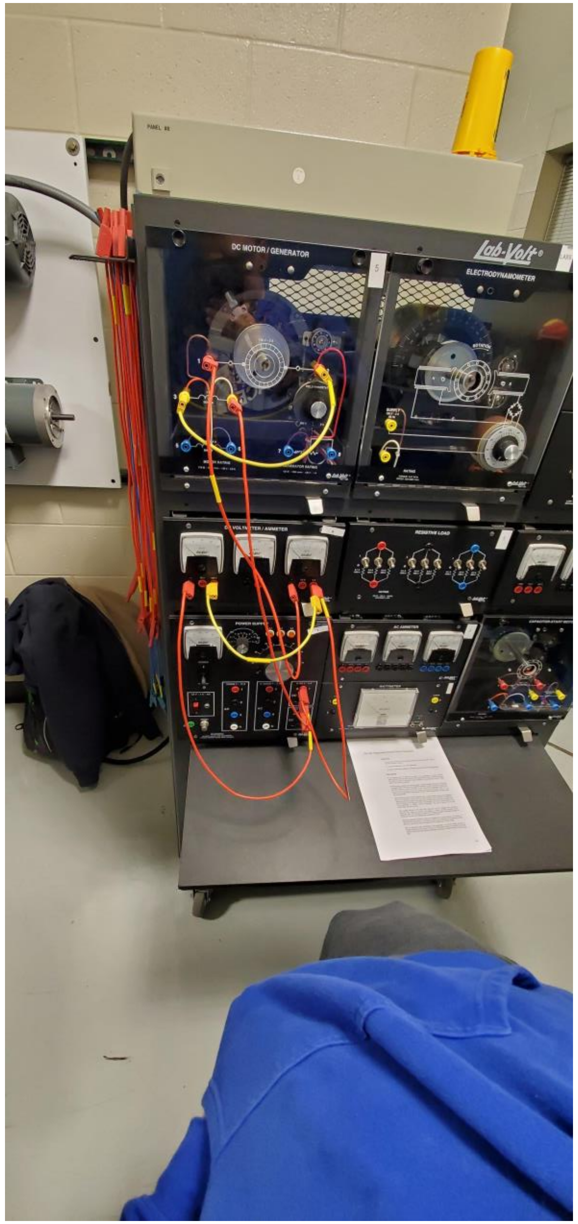
Objective

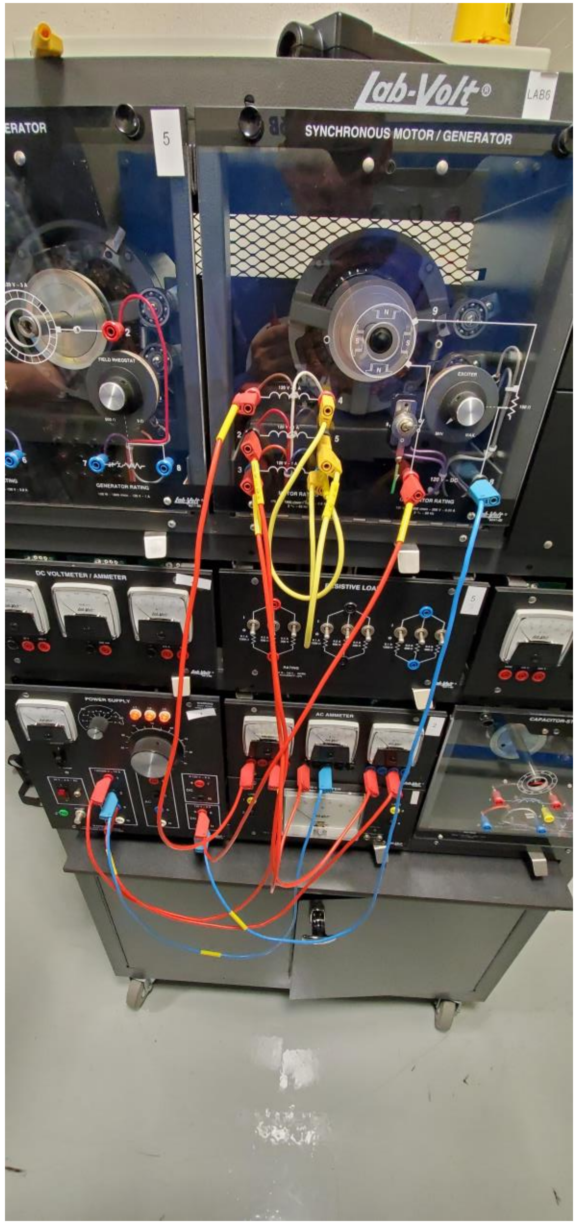
- **OBJECTIVE**
- To study the properties of the separately excited DC shunt generator under no load and full-load conditions.
- To obtain the saturation curve of the generator.
- To obtain the armature voltage vs armature current load curve of the generator.

Equipment needed

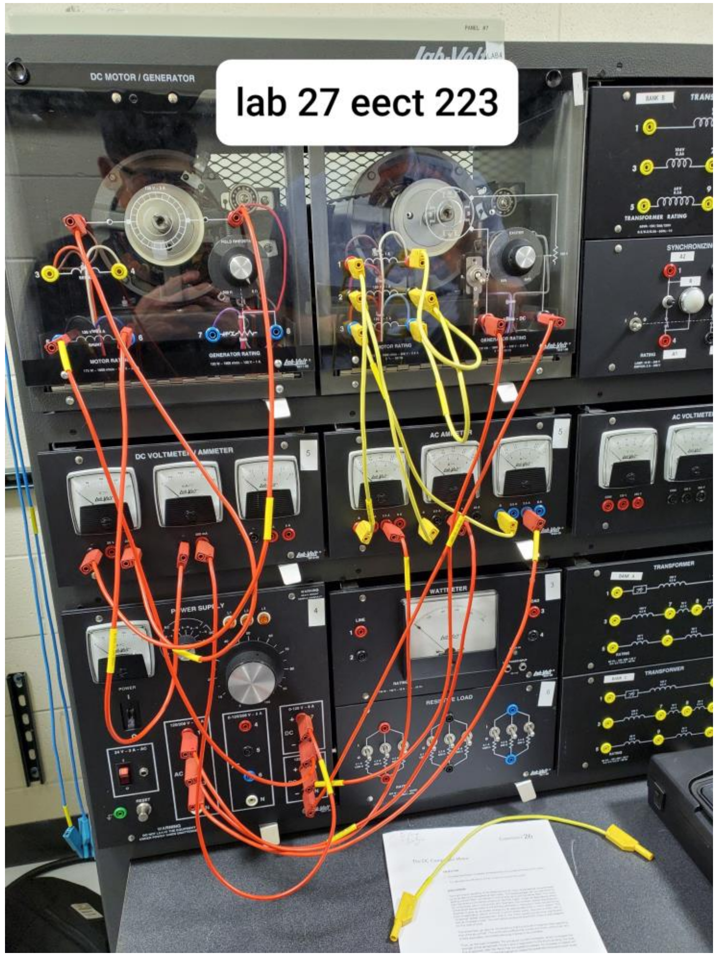
- 8110- Mobile Workstation
- 8211- DC Motor/Generator
- 8241- Three-Phase Synchronous Motor/Generator
- 8311- Resistive Load
- 8412- DC Voltmeter/Ammeter
- 8425- AC Ammeter
- 8821- Power Supply
- 8942- Timing Belt
- 8951- Connection Leads

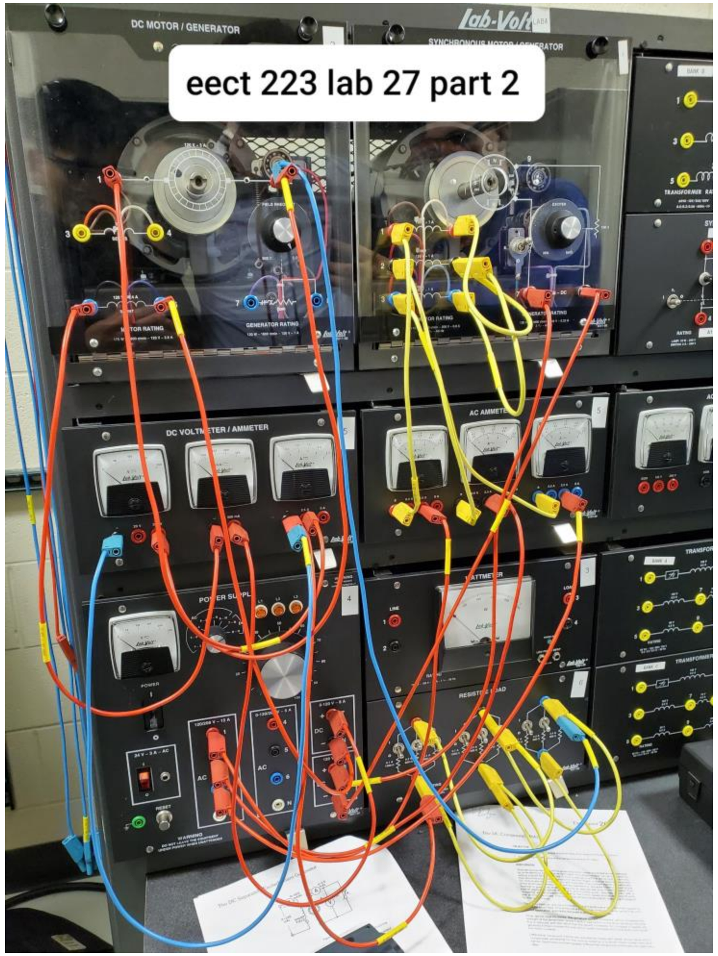
Experiment 27 - DC Separately Excited Shunt Generator





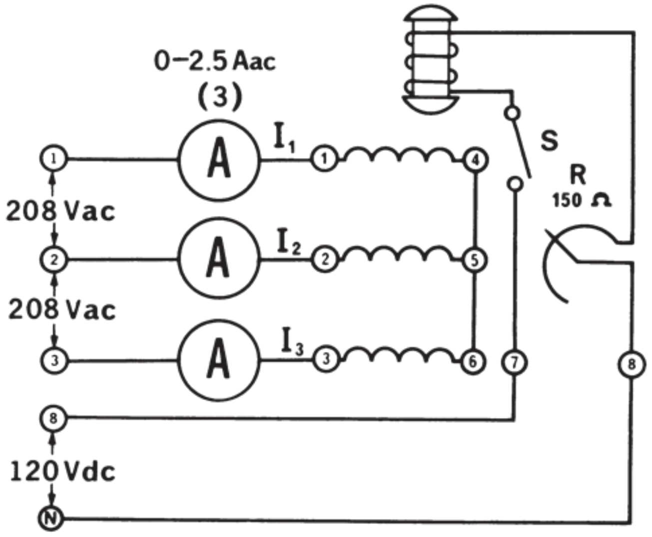
Experiment 27 - DC Separately Excited Shunt Generator





Observations

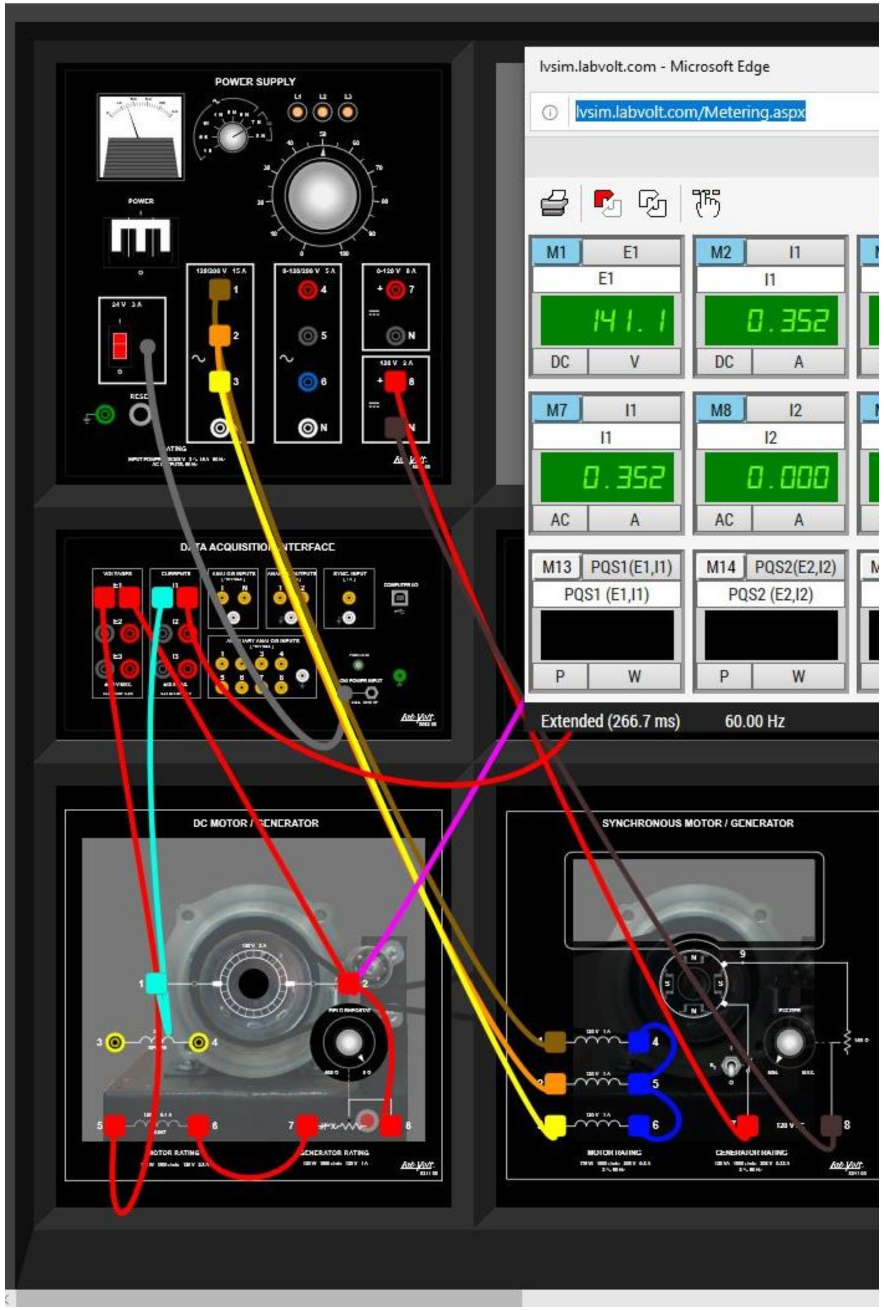
- Everything went smoothly for this lab. The reading’s we acquired compared to other work stations doing the same lab, our readings were similar to other lab groups after me and Caleb did a comparison with them.



Experiment 28 - DC Self-Excited Shunt GeneratorActions

Objective

- **OBJECTIVE**
- To study the properties of the self-excited DC shunt generator under no-load and full-load conditions.
- To learn how to connect the self-excited generator.
- To obtain the armature voltage vs armature current load curve of the generator.


POWER SUPPLY
lvsim.labvolt.com - Microsoft Edge
lvsim.labvolt.com/Metering.aspx
M1
E1
E1
141.1
DC
V
M2
I1
I1
0.352
DC
A
M7
I1
I1
0.352
AC
A
M8
I2
I2
0.000
AC
A
M13
PQS1(E1,I1)
PQS1 (E1,I1)
P
W
M14
PQS2(E2,I2)
PQS2 (E2,I2)
P
W
Extended (266.7 ms)
60.00 Hz
DC MOTOR / GENERATOR
SYNCHRONOUS MOTOR / GENERATOR

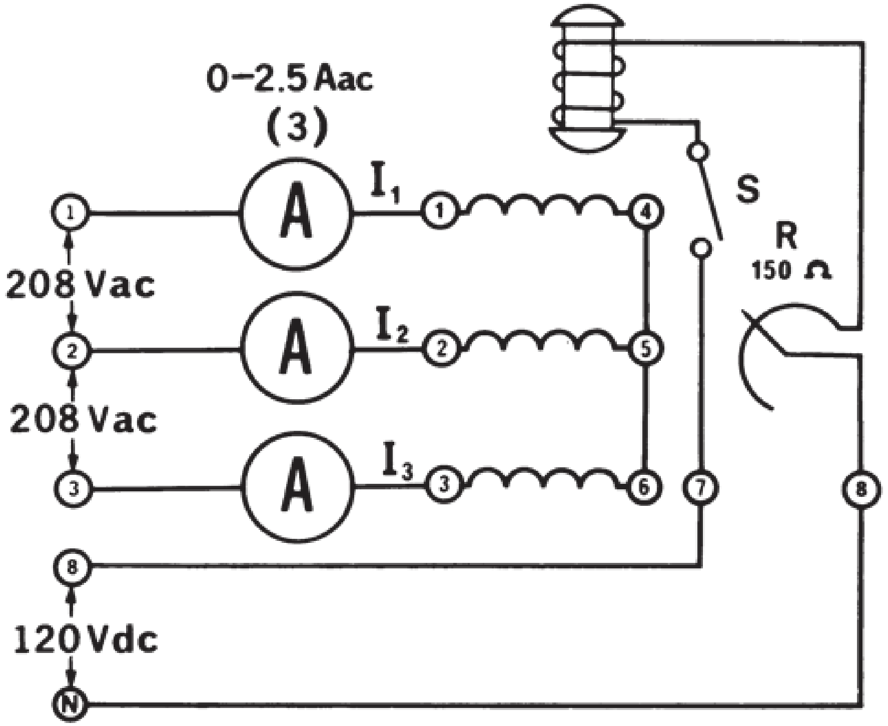

AC
A
AC
A
AC
A
M13
PQS1 (E1, I1)
PQS1 (E1,I1)
P
W
M14
PQS2 (E2, I2)
PQS2 (E2,I2)
P
W
M15
P
W
Sampling Window : Extended (266.7 ms)

Lab 28

Observations

- the field winding is connected to the generator output.
- Observed high no load voltage as we compare to the series dc generator. We observed also that when we add load resistance the current decreased and the full load voltage also decreased while the power generated by the circuit is increased.

Experiment 29 - DC Compound Generator



Objective

- **OBJECTIVE**
- To study the properties of compound DC generators under no-load and full-load conditions.
- To learn how to connect both the compound and the differential compound generators.
- To obtain the armature voltage vs armature current load curves for both generators.

Experiment 29 - DC Compound Generator

4c yes

4e 159.6 ACV

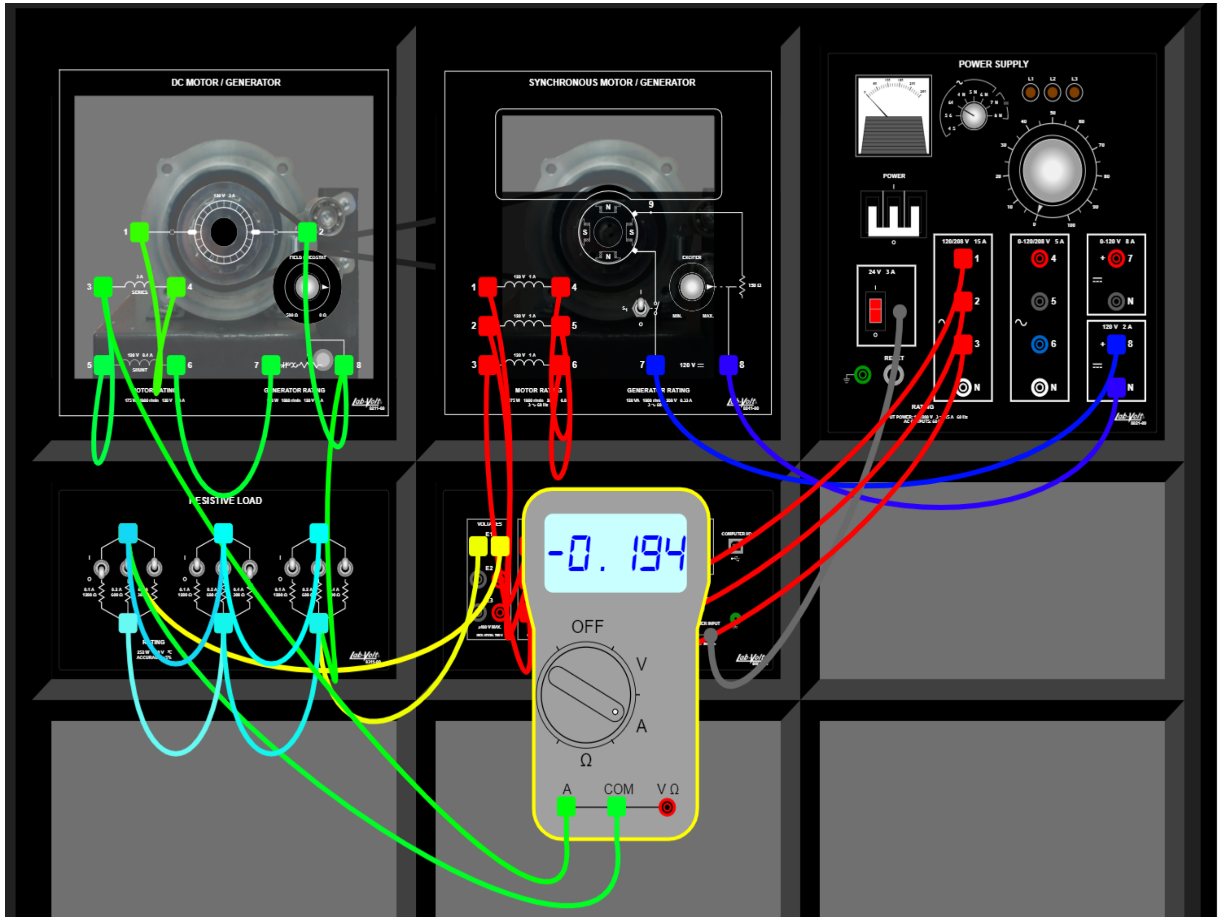
5 Yes, as resitance increases voltage decreases

6 120.9

7 R	I	E	W	
600	600	0.209	125.4	26.2086
300	300	0.425	127.7	54.2725
200	200	0.0643	128.6	8.26898
150	150	0.856	128.5	109.996
120	120	1.063	127.6	135.6388
100	100	1.263	126.3	159.5169
80	80	1.546	123.7	191.2402
75	75	1.637	122.7	200.8599

10 119

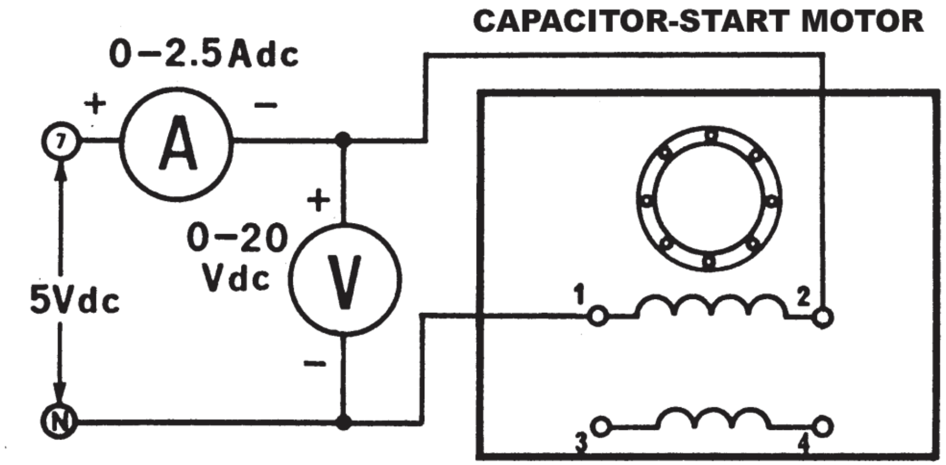
R	I	E	W	
	600	0.212	127.6	27.0512
	300	0.352	105	36.96
	200	0.385	77.06	29.6681
	150	0.355	53.35	18.93925
	120	0.346	41.56	14.37976
	100	0.294	29.45	8.6583
	80	0.249	19.96	4.97004
	75	0.24	18	4.32



Observations

- Connecting everything together was pretty straight forward but I had issues with lvsim crashing on me. I closed the window and redid everything and finally got it to function.

Experiment 31 - Split-Phase Inductor Motor Part I

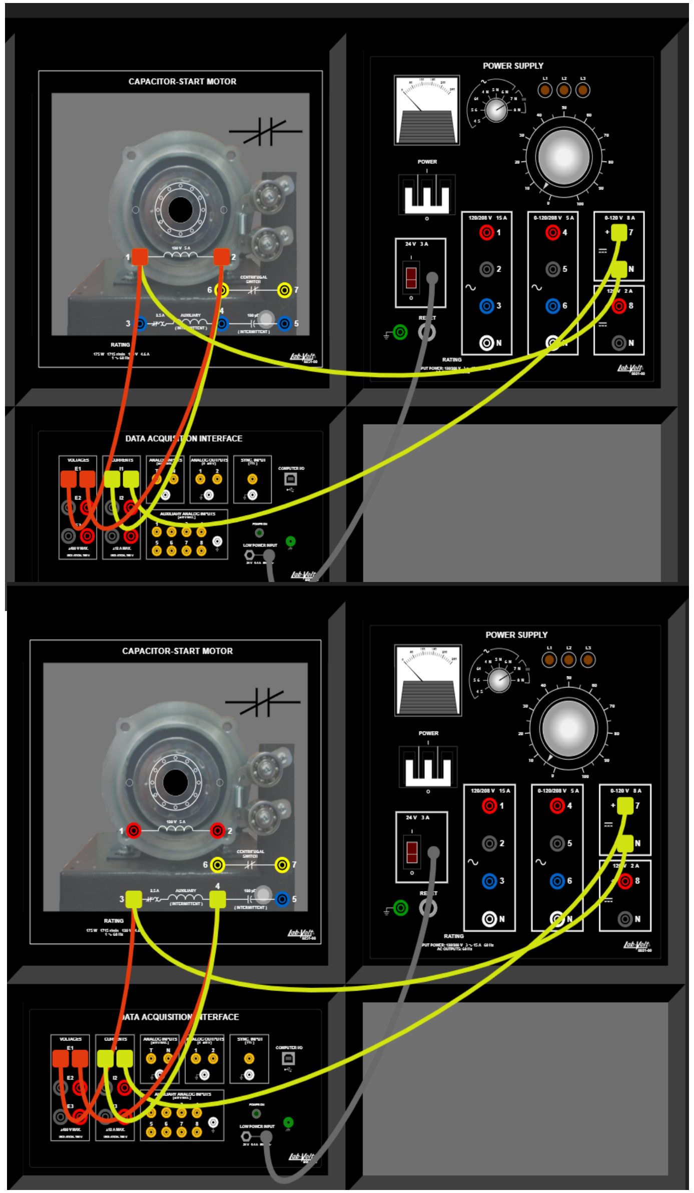


Objective

- **OBJECTIVE**
- To examine the construction of a split-phase motor.
- To measure the resistance of its windings.

Experiment 31 - Split-Phase Inductor Motor Part I

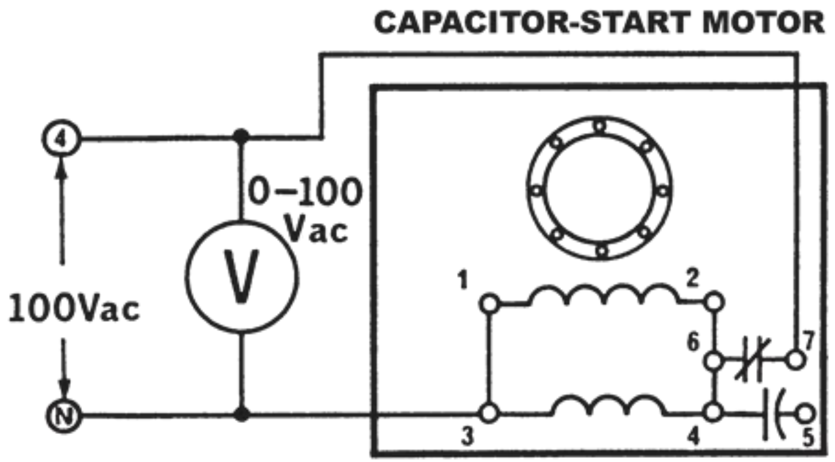
Q7	5.182	DC
	0.972	A
	5.331276	Ohms
Q9	5.443	DC
	0.64	A
	8.504688	Ohms



Observations

- split phase motors have 2 windings, a main winding and a start winding mainly just used to start the motor. The start winding has high resistance but low reactance while the run winding has low resistance but high reactance.

Experiment 32 - Split - Phase Inductor Motor Part II

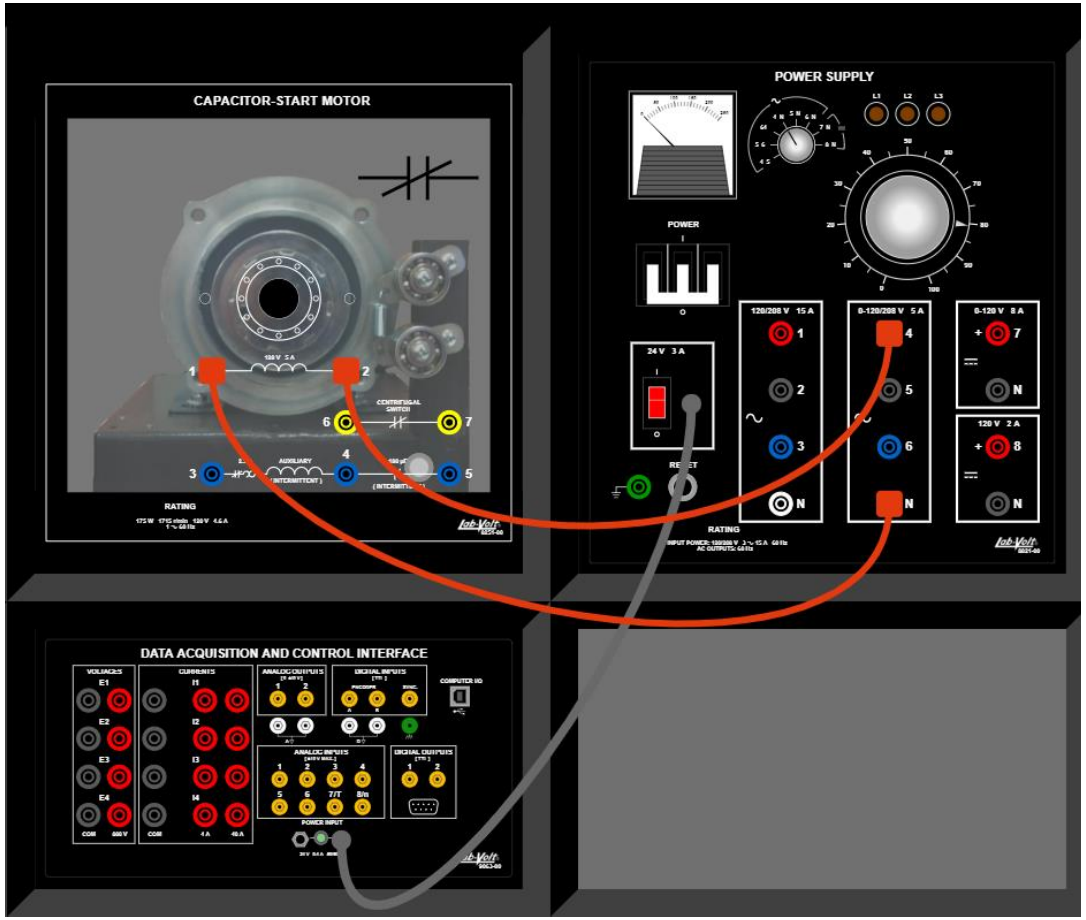


Objective

- **OBJECTIVE**
- To learn the basic motor wiring connections.
- To observe the starting and running operation of the split-phase motor.

Experiment 32 - Split -Phase Inductor Motor Part II

Q1b	100.4	
Q2d	No	
Q3	This does not work in the simulation	
Q4e	No	
Q5e	No	



Observations

- Lv sim kept freezing on me. I force closed my browser and reopened lv sim it started to function properly but I could not answer all the questions due to the simulation not functioning in simulation

Experiment 33 - Split - Phase Inductor Motor Part III

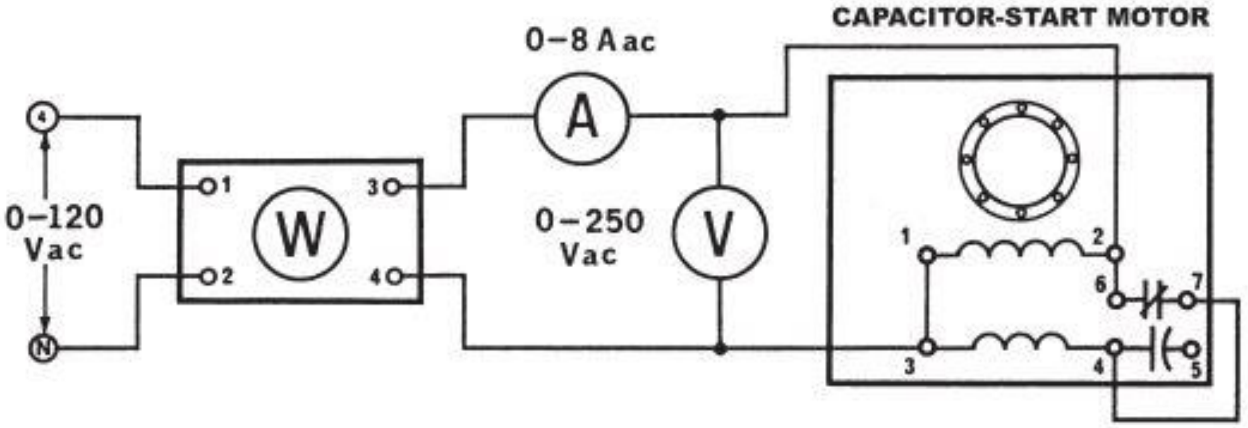
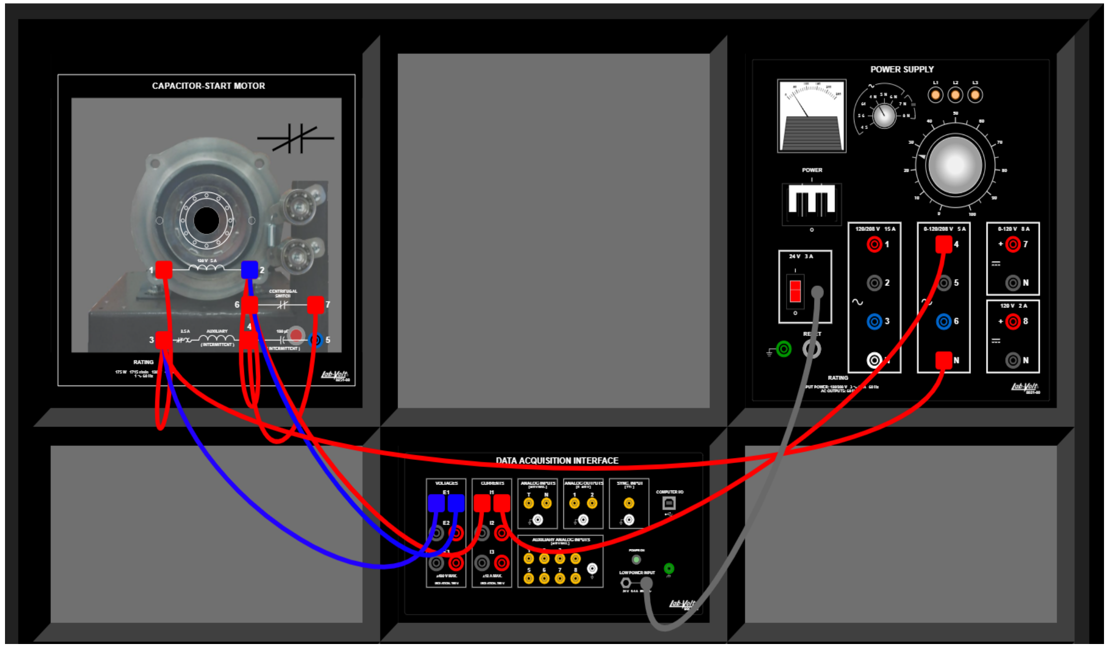


Figure 33-4.

Objective

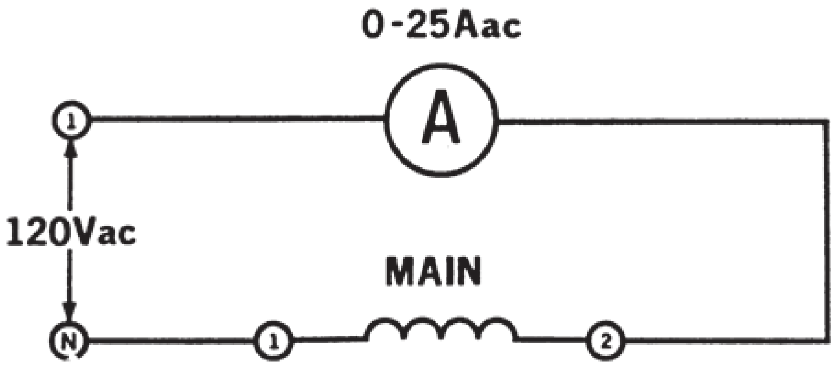
- **OBJECTIVE**
- To measure the starting and operating characteristics of the split-phase motor under load and no-load conditions.
- To study the power factor and efficiency of the split-phase motor.

Experiment 33 - Split -Phase Inductor Motor Part III



Q2	10	A	
Q3	9.975	A	
	V	A	I
Q6	114	9.878	620
	90.22	9.051	451
	60.98	6.324	213.6
	30.03	3.112	51.71

Experiment 34 - Capacitor-Start Motor

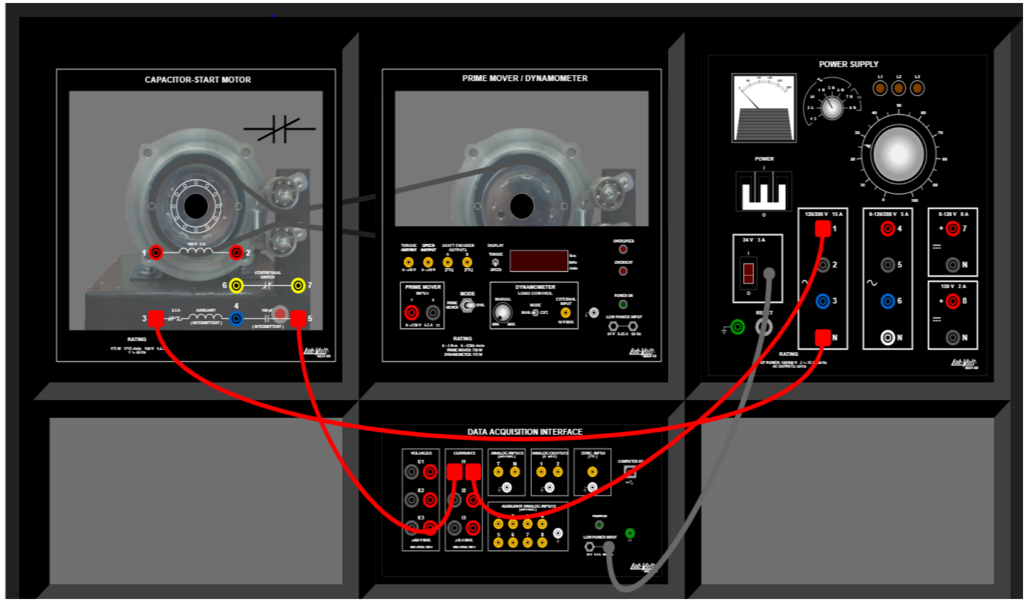


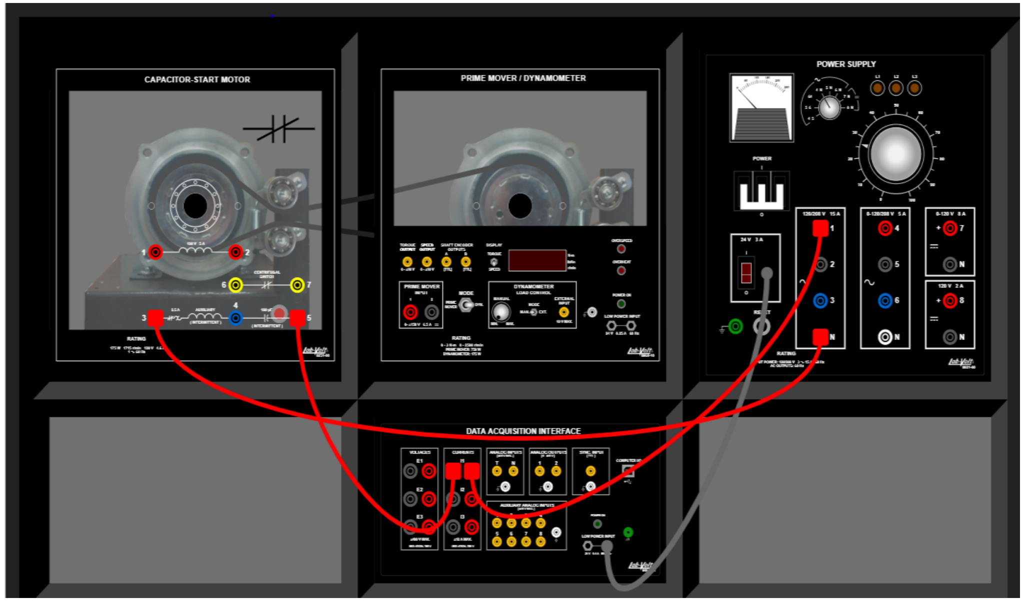
Objective

- **OBJECTIVE**
- To measure the starting and operating characteristics of the capacitor-start motor.
- To compare its starting and running performance with the split-phase motor.

Lab 34

W	RPM
156.5	1780
217	1765
286.3	1746
352.3	1727
432.6	1701

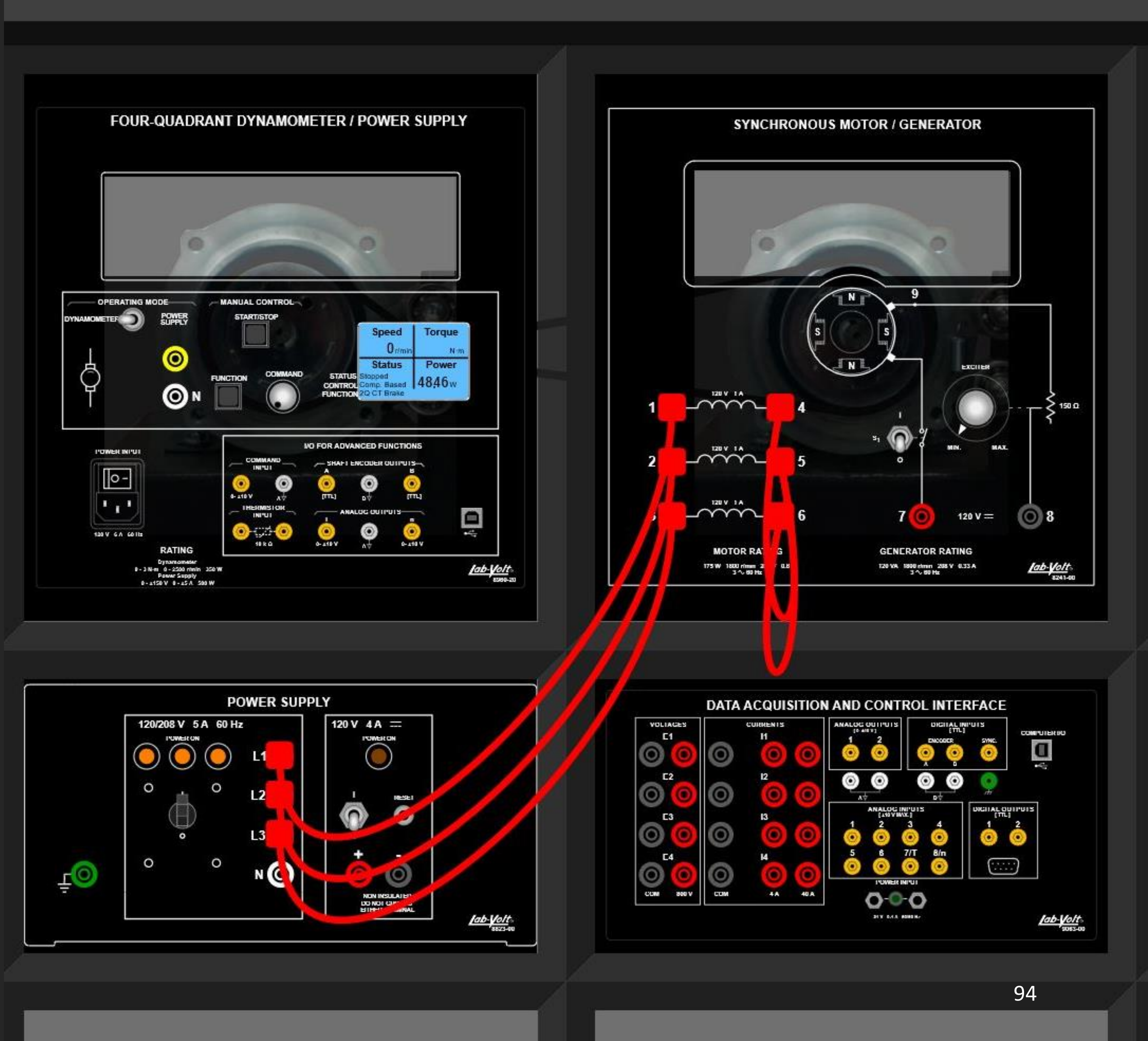




86364 - Three-Phase Rotating Machines

Exercises #1-1, #2-1, #3,-1

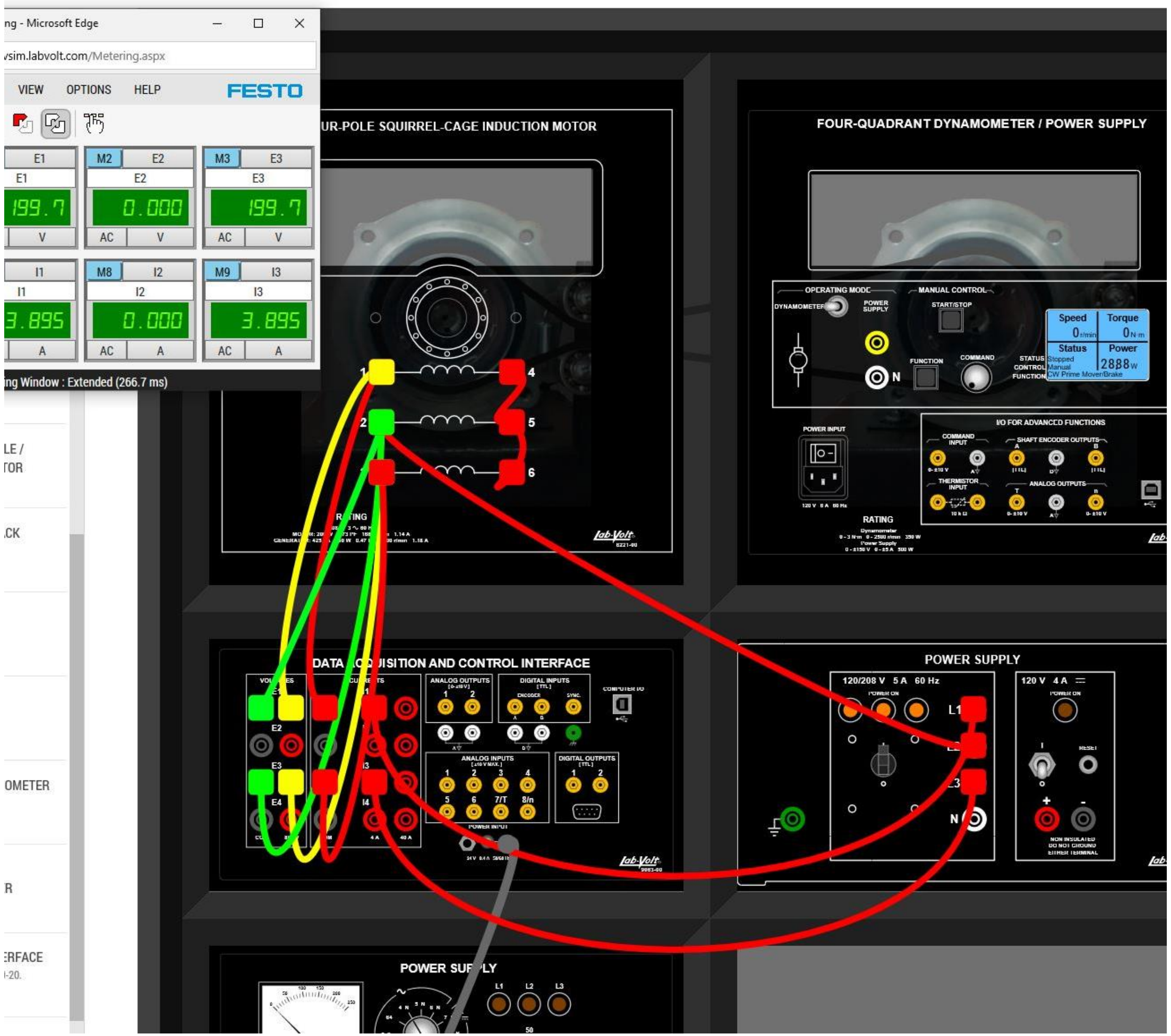
#1-1 Fundamentals for Rotating Machines



Observation 1-1

- We had noticed that as torque increases, the speed decreases but the power increases.
- That when the speed is negative the motor is running counter clockwise, and that the exciter controls the amperage and the frequency is cotrolled by the number of poles in the motor as well as the rpm.

1-2 The Three-Phase Squirrel-Cage Induction Motor



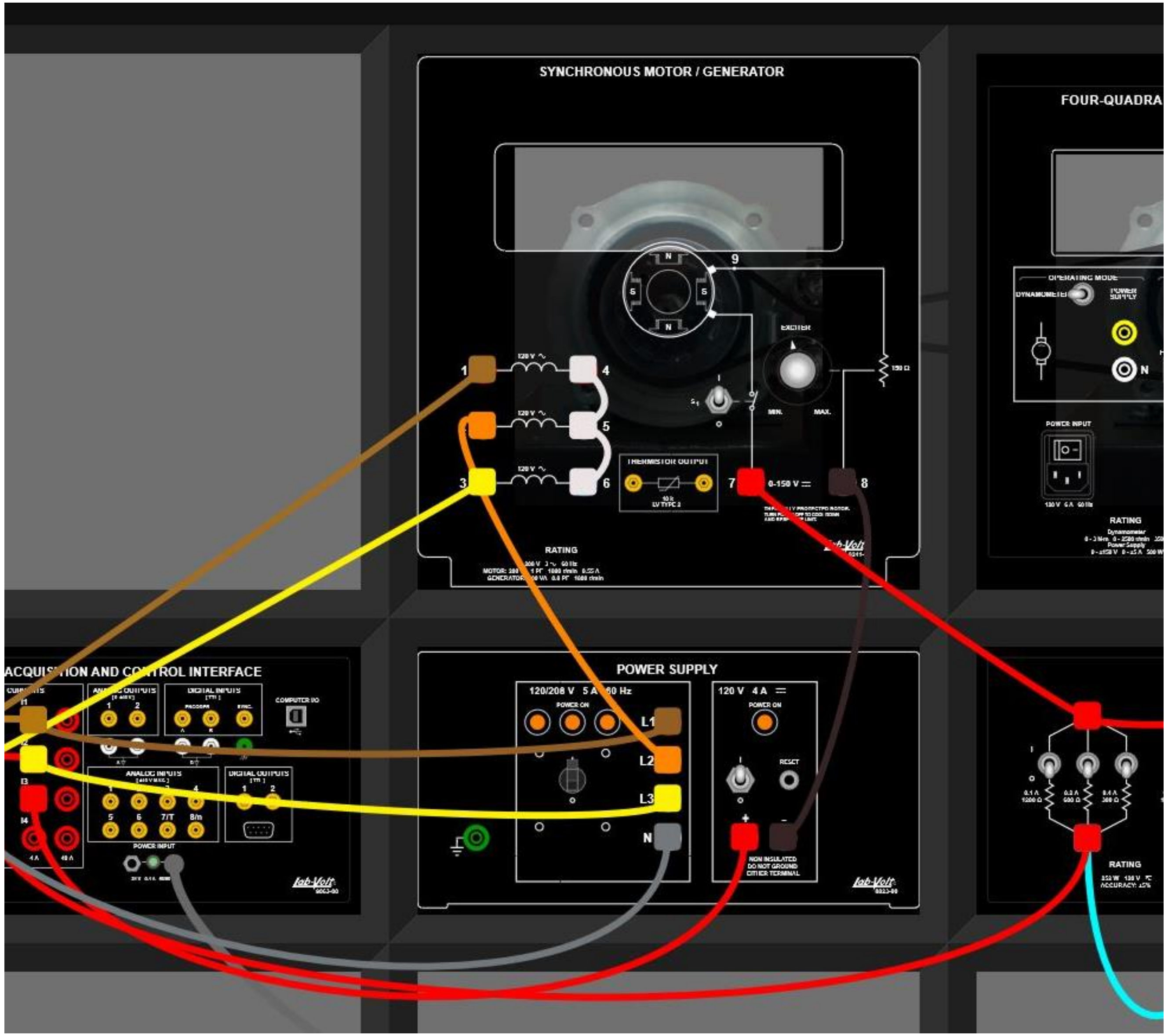
Observations 1-2 squirrel cage

When a 3 phase supply is given to the stator winding it sets up a rotating magnetic field in space. This rotating magnetic field has a speed which is known as the synchronous speed.

This rotating magnetic field induces the voltage in rotor bars and hence short-circuit currents start flowing in the rotor bars. These rotor currents generate their self-magnetic field which will interact with the field of the stator. Now the rotor field will try to oppose its cause, and hence rotor starts following the rotating magnetic field.

The moment rotor catches the rotating magnetic field the rotor current drops to zero as there is no more relative motion between the rotating magnetic field and rotor. Hence, at that moment the rotor experiences zero tangential force hence the rotor decelerates for the moment.

1-3 The Three-Phase Synchronous Motor



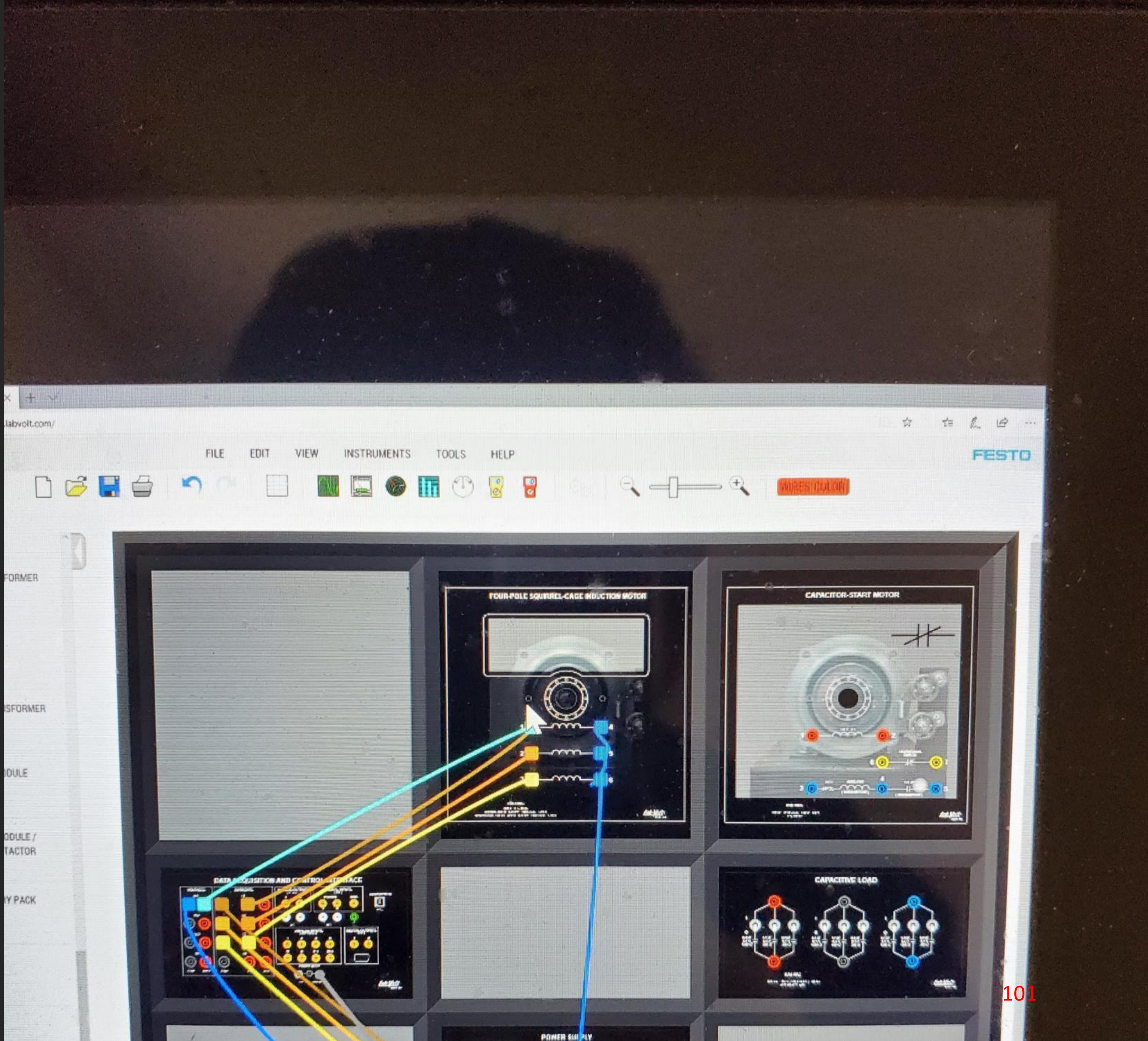
Observations

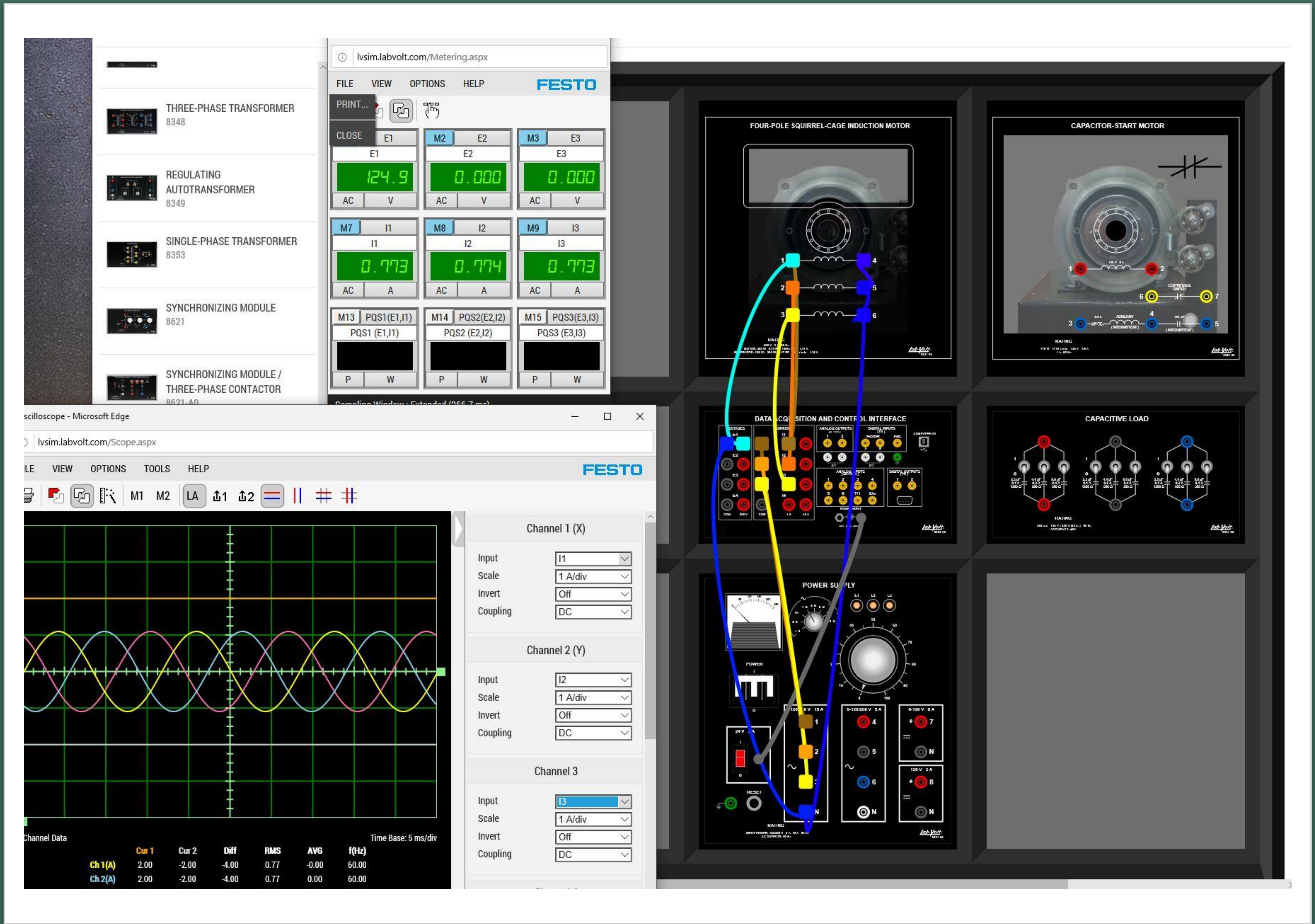
- We found that the speed of the rotor matches the speed of the rotating magnetic field.

88944 - Single-Phase Induction Motors

Exercise #1-1

1-1 Operation and Characteristics of Single-Phase Induction Motors




THREE-PHASE TRANSFORMER
8348
REGULATING AUTOTRANSFORMER
8349
SINGLE-PHASE TRANSFORMER
8353
SYNCHRONIZING MODULE
8621
SYNCHRONIZING MODULE / THREE-PHASE CONTACTOR
lvsim.labvolt.com/Metering.aspx
FILE
VIEW
OPTIONS
HELP
FESTO
PRINT...
CLOSE
E1 124.9 AC V
M2 E2 0.000 AC V
M3 E3 0.000 AC V
M7 I1 0.773 AC A
M8 I2 0.774 AC A
M9 I3 0.773 AC A
M13 PQS1(E1,I1) P W
M14 PQS2(E2,I2) P W
M15 PQS3(E3,I3) P W
scilloscope - Microsoft Edge
lvsim.labvolt.com/Scope.aspx
ILE
VIEW
OPTIONS
TOOLS
HELP
FESTO
M1
M2
LA
Channel 1 (X)
Input I1
Scale 1 A/div
Invert Off
Coupling DC
Channel 2 (Y)
Input I2
Scale 1 A/div
Invert Off
Coupling DC
Channel 3
Input I3
Scale 1 A/div
Invert Off
Coupling DC
Channel Data
Time Base: 5 ms/div
Cur 1 Cur 2 Diff RMS AVG f(Hz)
Ch 1(A) 2.00 -2.00 -4.00 0.77 -0.00 60.00
Ch 2(A) 2.00 -2.00 -4.00 0.77 0.00 60.00
FOUR-POLE SQUIRREL-CAGE INDUCTION MOTOR
CAPACITOR-START MOTOR
DATA ACQUISITION AND CONTROL INTERFACE
CAPACITIVE LOAD
POWER SUPPLY

1-1

Observations

- The current reading aqquired from the metering tab show that the current between i1, i2, and i3 are all similar to each other based on the inputt voltage at 124.8

Lv sim observations

- After having issues with lvsim not acting properly (sometimes) I found that the simulation software depends on the power of the computer running the lvsim. This could be why I had intermittent issues, which means I need a better workstation for long distance learning involving intricate simulation software.